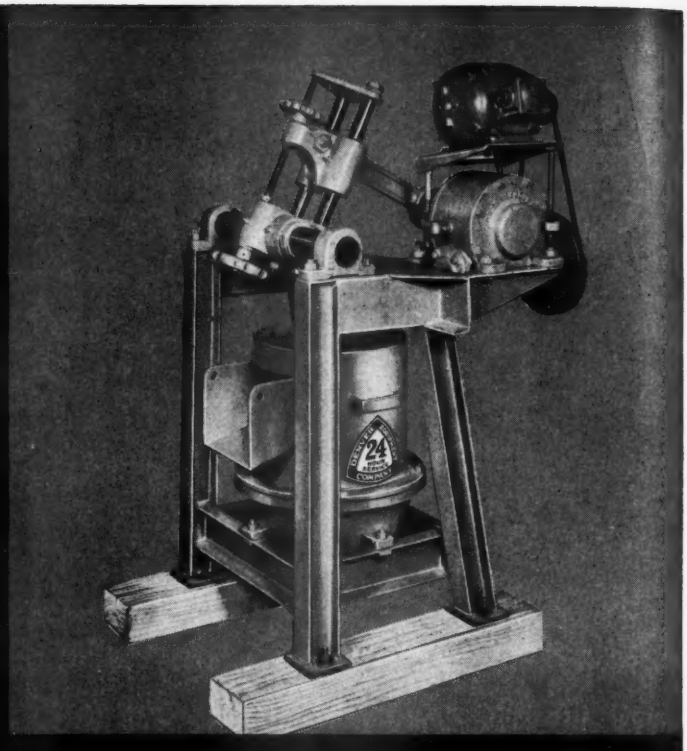
Mining

CONGRESS JOURNAL

JULY
1957

NEW 4"
DENVER
ADJUSTABLE
STROKE
DIAPHRAGM PUMP



Improved Design — Increased Capacity!

Space requirements have been reduced for easier installation and maintenance—only 50" high, only 680 lbs. Steel has replaced cast iron to reduce weight.

Lower horsepower is required because anti-friction bearing design practically eliminates friction. Ball bearings are used on crankshaft; Timken bearings on eccentric shaft and needle bearings on pivot points. Power is used to pump instead of overcoming friction.

A simplified drive uses standard 1800 rpm motor with V-belt drive to gear reducer.

Improved stroke adjustment tilts backward away from operator. As in all Denver Adjustable Stroke Diaphragm Pumps, adjustment can be made while pump is operating.

This new DECO pump offers you economical, high capacity, low maintenance pumping. Bayonet type or ball valves optional.

For full details, write for Bulletin No. P8-B10

H. W. Heckt, *a graduate mining engineer, has many years' mining and milling experience. His quick understanding of your problems and seasoned ability to recommend practical solutions is available to you. We hope you will consider his recommendations.*

NEW, IMPROVED DIAPHRAGM

- **This new, improved design makes possible a longer stroke and up to 75% higher capacity. Improved design also increases life of diaphragm.**
- **Molded rim evenly distributes tension to entire circumference.**
- **Diaphragm is clamped in place so there are no holes to weaken diaphragm.**
- **Molded rim means faster, simpler replacement. Only 6 bolts to take out to remove yoke-diaphragm unit from pump.**
- **Rubber diaphragm molded with nylon cord has a true catenary curve throughout the stroke, adding greatly to operating life.**

"The firm that makes its friends happier, healthier and wealthier"

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DENVER EQUIPMENT 24 HOUR SERVICE COMPANY

DENVER EQUIPMENT CO.

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Mining

CONGRESS JOURNAL

JULY, 1957

VOLUME 43 NUMBER 7

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Opinions expressed by authors within these pages are their own and do not necessarily represent those of the American Mining Congress

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for road screening operations it's . . .

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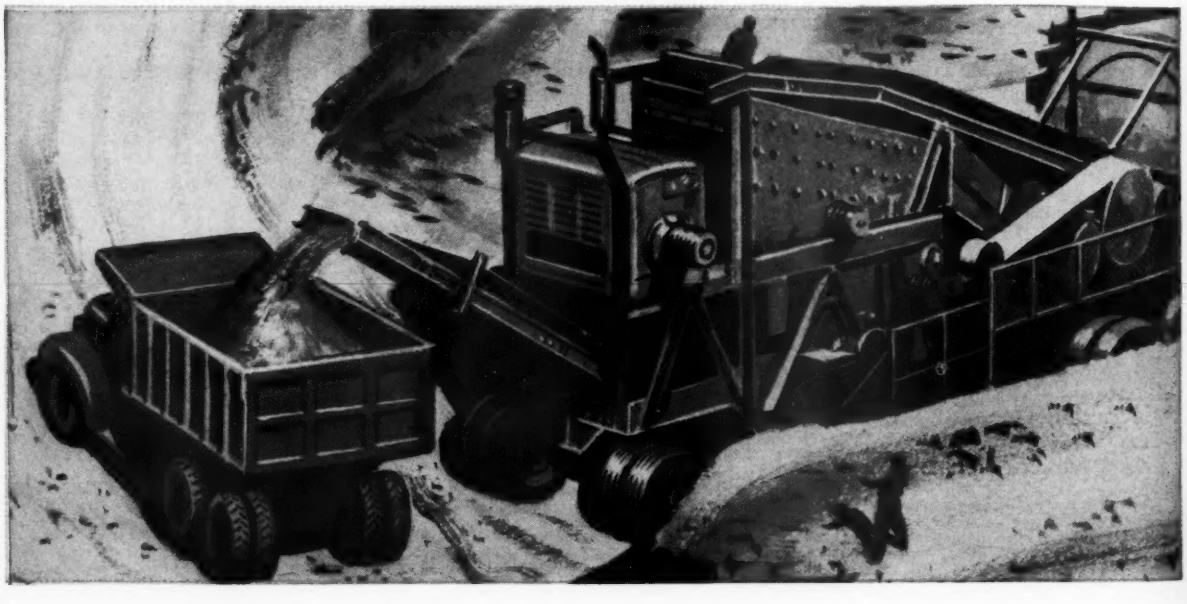
For accurate screening . . . maximum resistance to abrasion, vibration, and fatigue . . . long screen life and the assurance of large tonnage output at low cost . . . you can depend upon CF&I Industrial Screens. That's because CF&I Screens are made from specially selected steel, then crimped and woven extra tightly to assure maximum usage throughout screen life—even when subjected to severe corrosion, abrasion, or high temperatures.

Next time you need industrial screens, take a tip from the builders of the Nation's highways and choose CF&I Industrial Screens. You'll find it a profitable choice.



4483 CF&I **SPACE SCREENS**

THE COLORADO FUEL AND IRON CORPORATION

THE COLORADO FUEL AND IRON CORPORATION—Albuquerque • Amarillo • Billings • Boise • Butte • Casper • Denver • El Paso Ft. Worth • Houston • Lincoln (Neb.) • Los Angeles • Oakland • Oklahoma City • Phoenix • Portland • Pueblo • Salt Lake City • San Antonio San Francisco • Seattle • Spokane • Wichita

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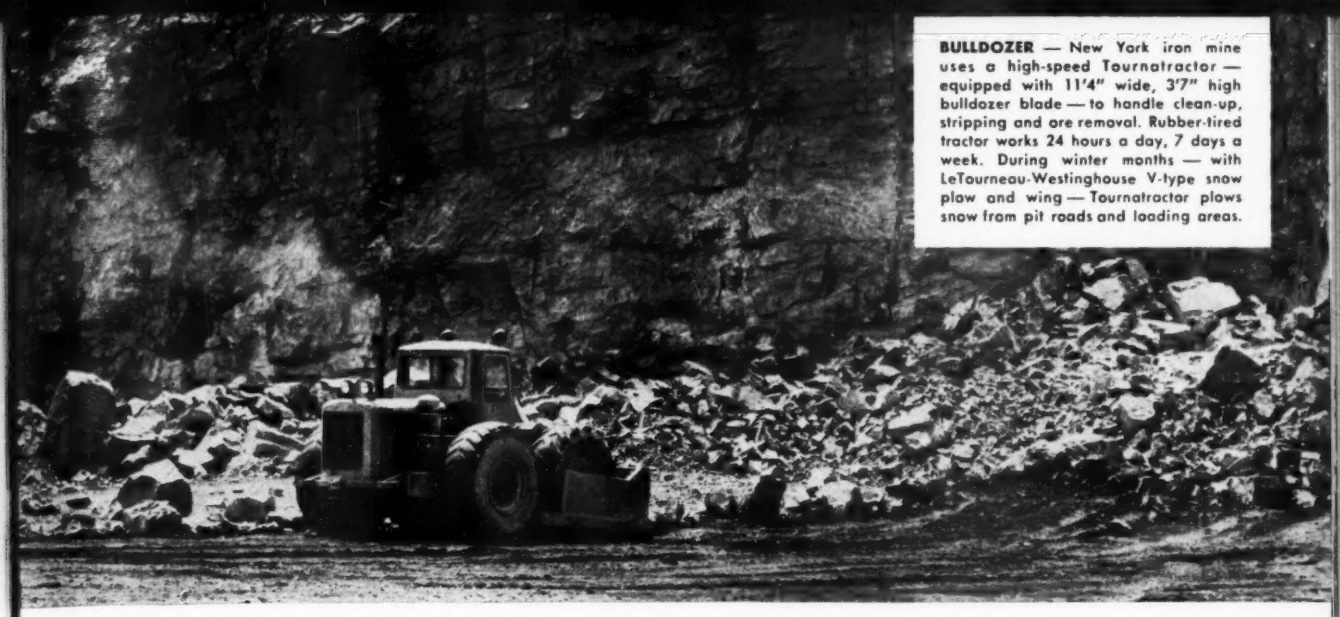


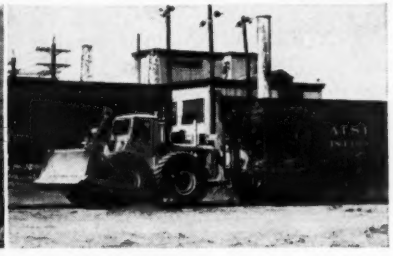
BULLDOZER — New York iron mine uses a high-speed Tournatractor — equipped with 11'4" wide, 3'7" high bulldozer blade — to handle clean-up, stripping and ore removal. Rubber-tired tractor works 24 hours a day, 7 days a week. During winter months — with LeTourneau-Westinghouse V-type snow plow and wing — Tournatractor plows snow from pit roads and loading areas.

Are you using 2 tractors where 1 would do?

SCRAPERS — At a southeastern open-pit phosphate mine, owners use 2 Tournatractor-drawn scraper teams for constructing levees around waste ponds. Optional LeTourneau-Westinghouse double-drum PCU efficiently operates any cable operated equipment.

TOWS EQUIPMENT — At a large midwest silica mine, Tournatractor also cuts downtime for air-compressors and other heavy equipment by moving them from one location to another *fast*. Tractor's big, low-pressure tires cross RR tracks, pavement, etc., without damage.

ANGLEDOZER® — Leading western copper mine uses Tournatractor — equipped with Angledozer blade — for clean-up of railroad tracks and loading area around widely-scattered shovels. 14'10" wide, 3'3½" high Angledozer blade can be angled 20° right or left.



SWITCHTRACTOR* — A southern uranium mine's Tournatractor—equipped with type "E" railroad coupler — spots ore cars in-between dozing chores. This versatile rubber-tired tractor can move 5 loaded or 18 empty cars up a 1 per cent grade.

This versatile rubber-tired LeTourneau-Westinghouse Tournatractor® can handle your scattered pit clean-up and road-maintenance jobs twice as fast as slower-moving crawlers. Here's why:

"Go-anywhere" mobility

High-speed Tournatractor *drives everywhere under its own power* — is never more than a few minutes away from its next assignment in your pit area. Rubber-tired tractor travels across pit floor, over railroad tracks, air-drill hoses, pavement, without damage.

Handles wide variety of jobs

With a L-W attachment to fit almost any work assignment, Tournatractor keeps busy productively all year-around. Use it for spotting rail cars . . . for fast push-loading or towing service . . . for heavy dozing to improve or construct haul-roads, detours or drainage. You'll find a single Tournatractor handles more work over a wider area — without excessive tractor moving expense — than 2 or more crawler-tractors! Why use 2 where 1 would do?

See Tournatractor in action

Why not let us arrange for a demonstration? See for yourself how LeTourneau-Westinghouse Tournatractor can lower costs and increase production at your pit. No obligation.

*Trademark CT-1495-M-1

LeTourneau-WESTINGHOUSE Company, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

WHERE QUALITY IS A HABIT

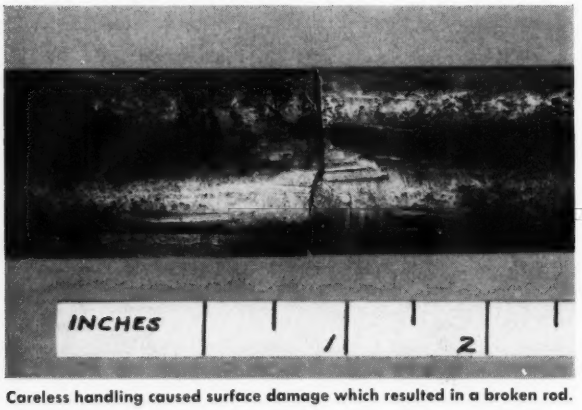
how to get the most out of HOLLOW DRILL STEEL

In a modern jackhammer, hollow drill rods must take between 1800 and 2000 jolting blows per minute. It's pretty rugged treatment for *any* steel – even Crucible's special alloy CA DOUBLE DIAMOND or 4E Hollow Drill Rods. That's why it's so important that you prevent unnecessary *abuse* of drill rods on the job. Here are a few tips that may save you time and money.

Take, for example,
DRILLING METHODS

ROD ALIGNMENT – A little extra care in properly aligning the drill rod so that the force of the piston is transmitted to the rock in a straight line will help reduce breakage a surprising amount. For bad alignment sets up severe stresses in the steel.

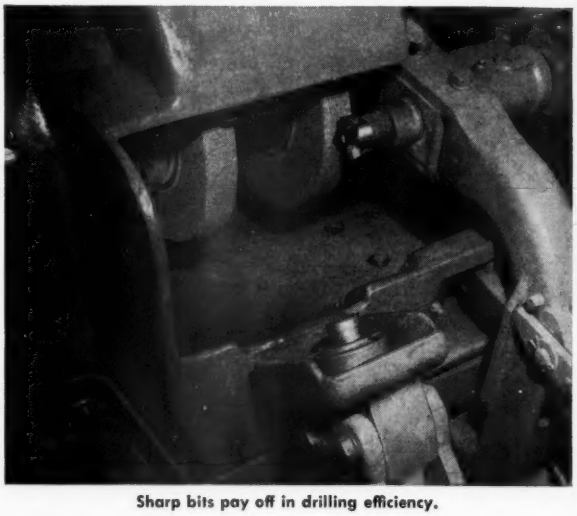
RATE OF FEED – Too slow a rate of feed forces the rod to absorb much of the impact – without a proportionate amount of hole being drilled. Too fast a rate results in a high breakage rate. Alloy rods – Crucible CA DOUBLE DIAMOND or 4E – allow faster drilling speeds than straight carbon drill rods used under the same conditions. That's because these alloy rods have higher hardness, tensile and yield strengths. The harder, more elastic alloy rod transmits the piston blow more efficiently than does the straight carbon drill rod.



Careless handling caused surface damage which resulted in a broken rod.

SURFACE DAMAGE – Damage to the surface of a drill rod may often lead to a broken rod. Nicks or deep tool marks cause stress concentration at the damaged spot.

BITS – Drilling with bits that have dull edges or gages badly worn creates a strain in the drill rod that prevents maximum efficiency. It pays big dividends to keep bits in good shape.


Sharp bits pay off in drilling efficiency.

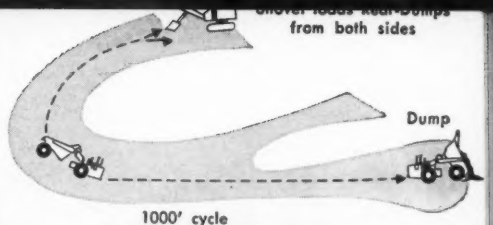
Actually, the solution to lower drilling costs–longer drill life–is simple: First, use the *right* drill rod and, second, apply a little extra care and common sense to machine setup and operation. It's well worth the effort.

Your nearby Crucible representative can give you helpful hints on other phases of drill rod care and operation–or arrange for *prompt* delivery of hollow drill rods in the sizes, types and grades you need. *Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.*

CRUCIBLE first name in special purpose steels

Crucible Steel Company of America

Haul heaped loads over slippery clay footing at Georgia Coating Clay Co. Pit



Within the year, Georgia Coating Clay Co. will produce 90,000 tons of kaolin at Pit #5 — one of their 5 mines in the Macon, Ga., area.

At this pit, 11 miles east of Macon, a 1½-yd. Koehring shovel and two 11-ton D Tournapull Rear-Dumps are stripping a 25′ layer of sand and red clay to expose rich kaolin deposits.

Hauls 7 yds. per load

Shovel operator heaped 7 yds. of overburden into Rear-Dump's wide (5′ 10½″) bowl in 1 min., 7 sec. Although rains made clay haul roads wet and sticky, each Rear-Dump consistently hauled heavy loads 500′ to dump site in average of 1 min., 24 sec. Haul included 200′ of 6% uphill grade out of the pit. On the dump, "D" backed in, spotted and dumped in 8 sec. Then, it pulled away and returned over same, slippery haul road to complete 1000′ cycle in average of 3 min., 49 sec.

According to Mine Supt. Frank Fountain, when clay road was dry, Tournapull Rear-Dumps cut cycle time to 3 minutes . . . increased production at the pit by one-third.

"Outstanding in rock"

Tournapull Rear-Dumps were moved to this tough stripping assignment, at Pit #5, after they profitably stripped 90′ overburden at Georgia Coating's other pits. Fountain said, "We were in trouble at this pit until we got these Rear-Dumps, and they brought us out. They did outstanding work in both tough rock and 'water sand'. I like 'em 'cause they're easy to maneuver under a shovel. They can pull themselves out of the soft dumps easy, too."

"D" scraper . . . valuable pit tool

Georgia Coating also uses a D Tournapull scraper on exploratory stripping operations. Besides stripping, versatile "D" loads, hauls and spreads sandy topsoil over the slick clay haul roads to speed hauling operations.

3 sizes; interchangeable work units

Tournapull Rear-Dumps are available in 3 sizes: 11, 22, and 35 tons. All can be interchanged with other trail units for year-round specialized work. Call or write for full specifications.

At a flip of a switch, operator activates electric switch to raise Rear-Dump body into dump position. Streamlined bowl sheds material fast. Note exposed kaolin in background.

Stripping 25′ overburden, shovel operator easily heaps good load into Tournapull Rear-Dump. Low rear-entry permits quick swing-out of empty dipper with door open.

D Tournapull scraper self-loads, hauls, and spreads topsoil over sticky roads to provide more traction for haulers . . . handles variety of pit jobs including exploratory mining.

Tournapull—Trademark Reg. U.S. Pat. Off. DRDP-1059-Q-b

LeTourneau-WESTINGHOUSE Company, PEORIA, ILLINOIS

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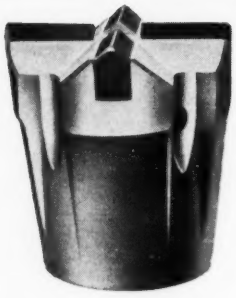
WHERE QUALITY IS A HABIT

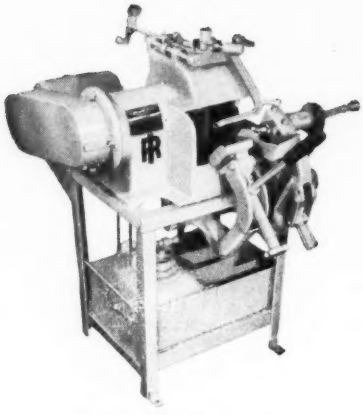
CARSET  JACKBITS

are PRECISION MADE

for HIGHEST PERFORMANCE

Maintain That Performance
by resharpening with
the NEW JC-3 JACKBIT GRINDER

- Grinds cutting faces to precisely correct profile for maximum drilling efficiency.
- Grinds bit gage to proper clearance.
- Eliminates waste of over-grinding.
- Greatly multiplies operator output.
- Available with electric, air or gasoline engine drive.



JC-3 Electric Drive Grinder

TO MAINTAIN the unequalled drilling speed of a NEW Ingersoll-Rand Carset Jackbit—and get maximum feet of hole from each bit — resharpening should be done to close tolerances and without unnecessary waste of the cutting material.

All of these requirements are met to excellent advantage with the new JC-3 Jackbit grinder — far more quickly, easily and accurately than by hand grinding methods. Ask your I-R representative for complete information on this time-saving, cost-saving machine. Or send for a copy of Bulletin 4187.

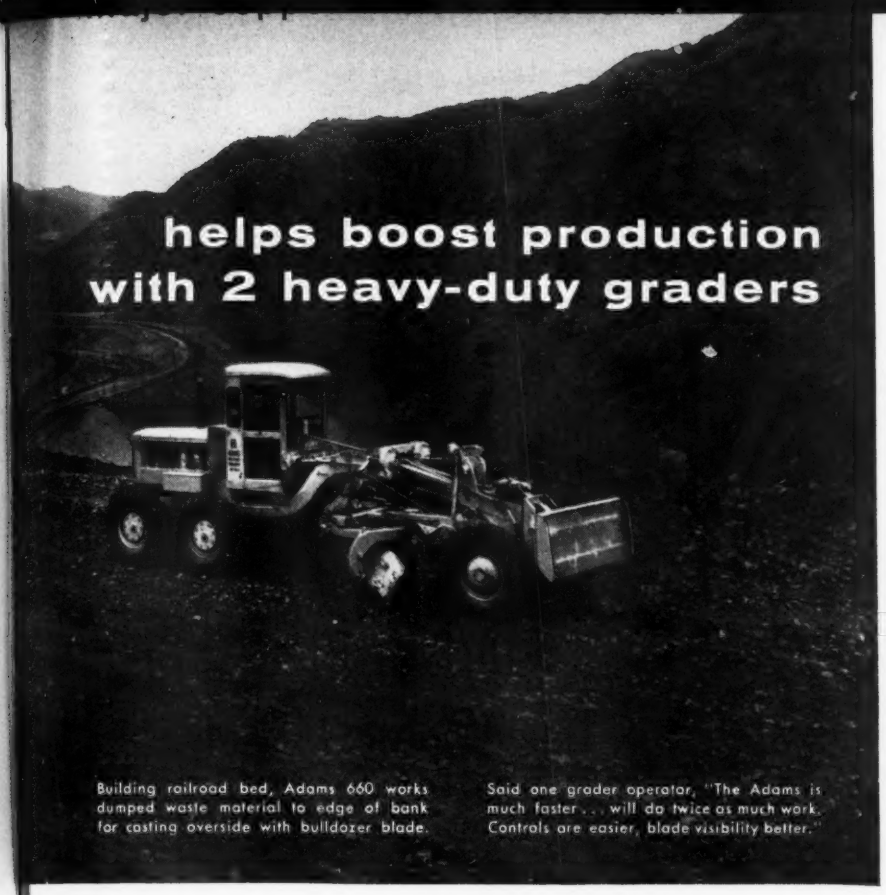
Ingersoll-Rand

11 Broadway, New York 4, N. Y.

COMPRESSORS • TURBO-BLOWERS • ROCK DRILLS
AIR TOOLS • CENTRIFUGAL PUMPS • CONDENSERS
GAS AND DIESEL ENGINES

15-518

helps boost production with 2 heavy-duty graders



Building railroad bed, Adams 660 works dumped waste material to edge of bank for casting overside with bulldozer blade.

Said one grader operator, "The Adams is much faster . . . will do twice as much work. Controls are easier, blade visibility better."

At a large open-pit mine in Arizona, ore is mined at low levels and hauled by railroad cars . . . at higher levels, overburden is removed by a fleet of 35-ton trucks. To help these haulers travel at safe, profitable speeds, and to speed road and rail-spur construction — the mine uses two 150 hp Adams* 660 graders.

Patrols roads 24 hrs. a day, 6 days per week

One of the heavy-duty "660" LeTourneau-Westinghouse units is used primarily for maintaining many miles of haul roads. This fast-moving grader patrols these busy mine roads 24 hours a day, 6 days a week. It goes wherever needed . . . to fill ruts, level washboard, clear debris dropped by overloaded haulers and improve drainage.

For working along steep drop-offs, the Adams' standard blade extends a full 7½ ft. beyond wheel line, to give operator safe working margin. Extra-safe dual-braking system stops transmission as well as tandem drive-wheels for sure, safe stops and minimum brake wear.

Helps build new roads, RR grades

The second "660" grader — equipped with bulldozer blade — is used on new construction work and for maintaining waste dump. When constructing new roads or railroad beds, the "660" handles all the blade work.

Works any kind of material

Wide range of speeds give Adams advantage for working efficiently in any kind of material. All 80 to 150 hp Adams graders have an 8 forward and 4 reverse speed transmission. In addition, optional 3-speed "creeper" gears (0.23 to 1.82 mph) may be added. These low, full-power speeds move heavier loads, handle rocky material with greater speed and safety, insure more accurate blade control for fine finishing around forms or obstructions.

Adams' largest grader — the powerful 190 hp POWER-*Flow* 660, with torque converter — gives you an infinite number of speeds forward to 27.4 mph . . . reverse to 24.4 mph. Adams' smallest, the 60 hp "220", has 5 speeds forward to 18.3 mph — best in its class.

See Adams in action

Why not see how you, too, can step up mine and quarry production, cut operating costs — with heavy-duty Adams graders? There are 6 models: 190, 150, 123, 115, 80, 60 hp. Choice of GM or Cummins engines on 5 larger models. Call or write for a demonstration at your pit.

With dozer blade, "660" maintains waste dump. Over 72% of the total amount of material mined at this copper mine is waste.

Powerful "660" helps build exploration roads and RR road beds fast and easy. Commenting on the Adams grader, the second operator said, "I like the power and weight of the '660'. Also, the big 14-ft. moldboard and wide choice of speeds."

*Trademark G-1483-M-1

LeTourneau-**WESTINGHOUSE** Company, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

WHERE QUALITY IS A HABIT

15-518

REDUCE THE MOISTURE CONTENT of Your Coal

from 35%

to 7%

to 6%

to 5%

Yes, even less

Remarkable performance records over the years prove that C.M.I. continuous centrifugal dryers cannot be beat.

C.M.I. Dryers not only reduce surface moisture content from 35% to *less than 5%*, but also will do a fine job in recovering coal from slurry.

Yes, C.M.I. Coal Dryers and efficient coal mining operations go together. Our engineers are available to render prompt service, whenever and wherever needed.

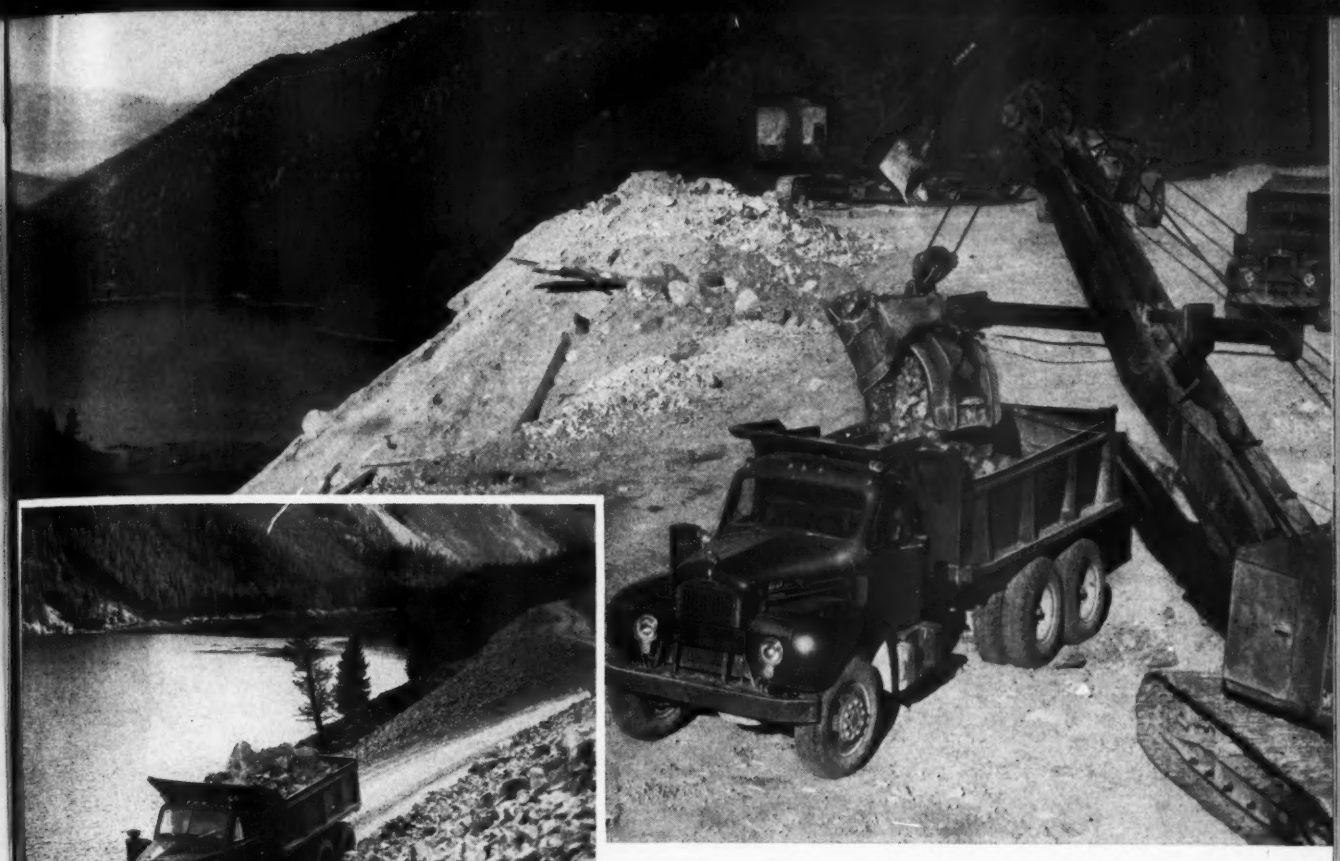
Write, wire or phone for complete details. No obligation.

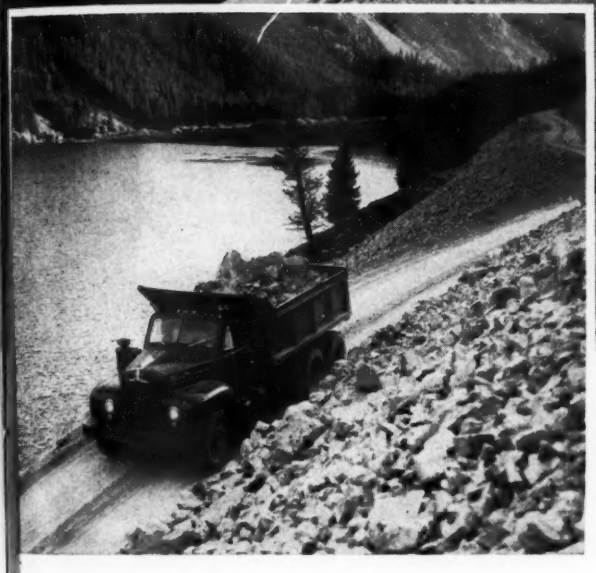
with C·M·I CONTINUOUS CENTRIFUGAL coal dryers

C·M·I Centrifugal DRYERS

CENTRIFUGAL & MECHANICAL INDUSTRIES, INC.

146 PRESIDENT STREET • SAINT LOUIS 18, MISSOURI





Loading tungsten ore near Glen, Montana, at the Ivanhoe Mine of Minerals Engineering Company.

(Left) ***Winding mountain roads*** and steep grades call for trucks with top performance and alert, skillful drivers.

Mile-high hauling in the Rockies... stern test for men and trucks

Sixteen hours a day—6 days a week—52 weeks a year—these Mack six-wheelers haul 18-ton loads of precious tungsten ore nine miles from mine to processing mill. The mine is at 7,100 feet elevation; the mill at 5,200 feet. It's a tough haul over adverse terrain . . . especially hard on trucks during the winter months.

Mr. W. M. Gaylor — contract hauler from Dillon, Montana — says: "Considering that each Mack working the Ivanhoe Mine averages 30,000 tough miles a year, engine down time has been very small. What also impresses me is the Mack four-wheel-drive bogie rear ends. In three years of operation, there has not been a single second of down time on these rear ends. The same applies to king pins and bushings.

"When you consider that our diesel fuel mileage runs 6½ miles per gallon, you have to agree these Macks are sure hard to beat for dependable and cost-saving hauling."

Mr. Gaylor speaks from experience about the superiority of Mack trucks. Want more information? Let your local Mack representative show you how Macks have paid off for operators in your area. Mack Trucks, Inc., Plainfield, New Jersey. In Canada: Mack Trucks of Canada, Ltd.

4798

MACK
first name for
TRUCKS

THIS JOY BIT DRILLED *46% Farther*... STILL MORE TO GO

YOU'LL FIND YOUR BIT SIZE IN THIS CHART

SHOULDER DRIVE	BOTTOM DRIVE	TAPER SOCKET
1½"		1¼"
1⅝"		1⅜"
1¾"		1½"
1⅞"		1⅝"
2"		
2⅛"	2½"	
2¼"	2¾"	
2⅜"	3"	
2½"	3¼"	
2¾"	3½"	
3"	4"	
3½"	4½"	
4"	5"	
4½"	5½"	
	6"	

Note: Shaded areas are X-Type, others are Cross Type

WRITE FOR FREE BULLETIN 172-3

Drilling Rock with a scleroscope hardness of 90-100 takes a lot out of most carbide bits . . . on this job, other bits were averaging 532 feet. Our illustration shows a Joy bit before and after drilling almost 800 feet in this formation. The average for Joy bits on the entire job was 781 feet.

Here's why: OFFSET WINGS allow drag-free rotation, faster removal of cuttings, easy reconditioning . . . DEEP SLOTTED CHIP WAYS allow cuttings to escape; bit does not regrind its own cuttings . . . INSERT STAYS IN because of new brazing method . . . SPECIAL ALLOY STEEL BODIES heat treated for shock resistance and high fatigue life . . . PRECISION MILLED THREADS instead of tapped threads.

These are the reasons why Joy tungsten carbide bits give extra footage . . . and only Joy bits have all these features. Let your Joy representative prove it to you. ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

WSW C 6595-172

JOY ... EQUIPMENT FOR MINING ... QUARRYING ... CONSTRUCTION

Portable Air Compressors

Wagon Drills

Drilling Bits

Hand-Held Rock Drills

65 belt hp!
up to 15,500 lb drawbar pull!
forward speeds from 1.5 to 5.5 mph!
reverse to 4.1 mph!

ALLIS-CHALMERS

HD-6

Tractor-Dozer

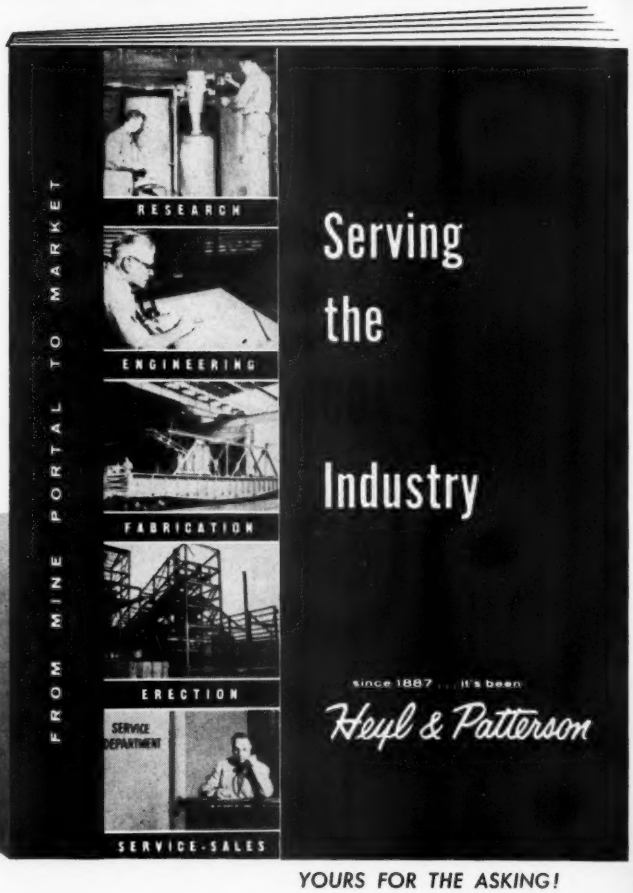
MORE POWER—BETTER DOZING SPEEDS—BIG-DOZER DESIGN—NEW HANDLING EASE!

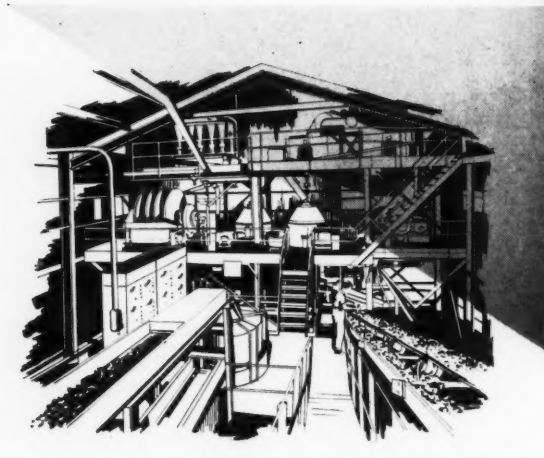
Only dozer of its size with these basic advantages . . . engine-mounted rams, long push beams, fewer linkage points (only 2 instead of 5 or 6). These big-dozer features all combine to provide more accurate, gouge-free dozing . . . longer equipment life.

Convenient rotary-valve blade control makes the HD-6 the easiest handling dozer of its size. With more than 5½ feet of track on the ground, it has outstanding flotation . . . yet turns easily in any terrain. The HD-6 also combines large, low-set front idlers with a blade snugged close to the radiator guard . . . to provide balance that means better dozing, more work done under any conditions!

You can <u>see</u> it . . . but there's only one way to <u>prove</u> it—on **your** job!

for the file of COAL PREPARATION MEN...





YOURS FOR THE ASKING!

THE PURPOSE OF THIS BOOKLET

is to describe some of the more recent facilities built by Heyl & Patterson for the coal mining industry, with emphasis on the H & P Fine Coal Washing and Water Clarification Circuits. Further, there are condensed descriptions of some of the special equipment incorporated in the H & P Circuits.

- **COMPLETE COAL PREPARATION PLANTS**
- **BRADFORD COAL BREAKERS** ● **H & P WET CYCLONES**
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Call your nearby Allis-Chalmers construction machinery dealer —he'll demonstrate one on your job NOW!

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For drifters, sinkers and stopers...

New TIMKEN® threaded carbide bit

clears chips faster.. lasts longer.. cuts cost

New frontal design shoots jets of water against the face from five specially positioned front holes, washes chips back faster. You get better cutting action with less drag, because center hole is larger, recess deeper. *Cuts your cost per foot-of-hole.*

New wing design... deeper, wider clearance between the wings works with five front holes. Water carries chips away faster from the cutting face, speeds drilling, boosts cutting efficiency. *You get lower cost per foot-of-hole.*

Deeper relief under the heel provides extra clearance for washed-back chips, cuts bit drag, adds to bit life. The deeper relief and redesigned heavier wing help drilling go faster, *lower your cost per foot-of-hole.*

New wear-resistant carbides increase bit life. Special analysis carbides provide better wear-resistance, added shock-resistance. Bit can be reconditioned many times. Another feature that gives you *lower cost per foot-of-hole.*

Improved thread contact reduces breakage, gives you longer bit life, *lowers your cost per foot-of-hole.* Send today for free brochure. The Timken Roller Bearing Company, Rock Bit Division, Canton 6, Ohio. Cable address: "TIMROSCO".

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- **all units completely dismantled and every part carefully inspected**
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Helps Us Market Good Coal"

SAHARA COAL FOR SALE HERE
THE SIGN OF GOOD COAL

says **HENRY C. WOODS**
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"To back up our company creed, 'The Sign of Good Coal,' we must mine quality coal and deliver it in the size ordered. AIRDOX assures this by *producing unshattered coal* in the mine . . . *reducing degradation* in transit. In other words—AIRDOX helps us market good coal by minimizing disintegration.

"It is also the best method for us because it produces less fines, reduces cleaning costs and makes loading easier, faster. No other method gives us these cost-cutting advantages . . . plus the uniform quality coal demanded by users today! We were one of the first to use AIRDOX in southern Illinois and have used it consistently ever since."

AIRDOX

NON-EXPLOSIVE MINING METHOD

Cuts Costs 5 Ways

- **Produces less fines in face preparation**
- **Rolls coal forward for faster, easier loading**
- **Easier on "tender" roofs—cuts timbering, bolting**
- **Lowers cleaning costs by minimizing fines**
- **Reduces degradation—no shattered coal**

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if you didn't get haulage ways last year!

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Ohio Brass Co.
Mansfield, Ohio

Haulage Ways is an 8-page monthly bulletin published by the Ohio Brass Co. and sent free of charge to 8,000 mining men in the U.S. and abroad.

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Continuous Mining Machines

JEFFREY NOW OFFERS a full range of heights in time-saving, cost-saving continuous mining machines. You can have all the advantages of continuous mining in seams as low as 28" with the new 86A Colmol .... make cuts up to 96" high with the 76CM Colmol. And there is a complete range of in-between sizes.

The new 86A Colmol makes a cut 28" high and 14'7" wide, gives good cleanup and smooth bottoming. A newly designed gathering chain cuts the bottom 8" of coal and leaves no valleys. Coal is carried to the center of the Colmol, then up the center onto the swinging discharge conveyor.

With a Colmol, coal is broken from the face, not ripped or ground off. You get more favorable overall screen consist, as well as extra speed and efficiency.

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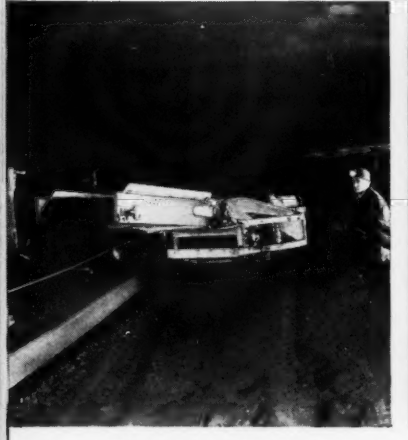
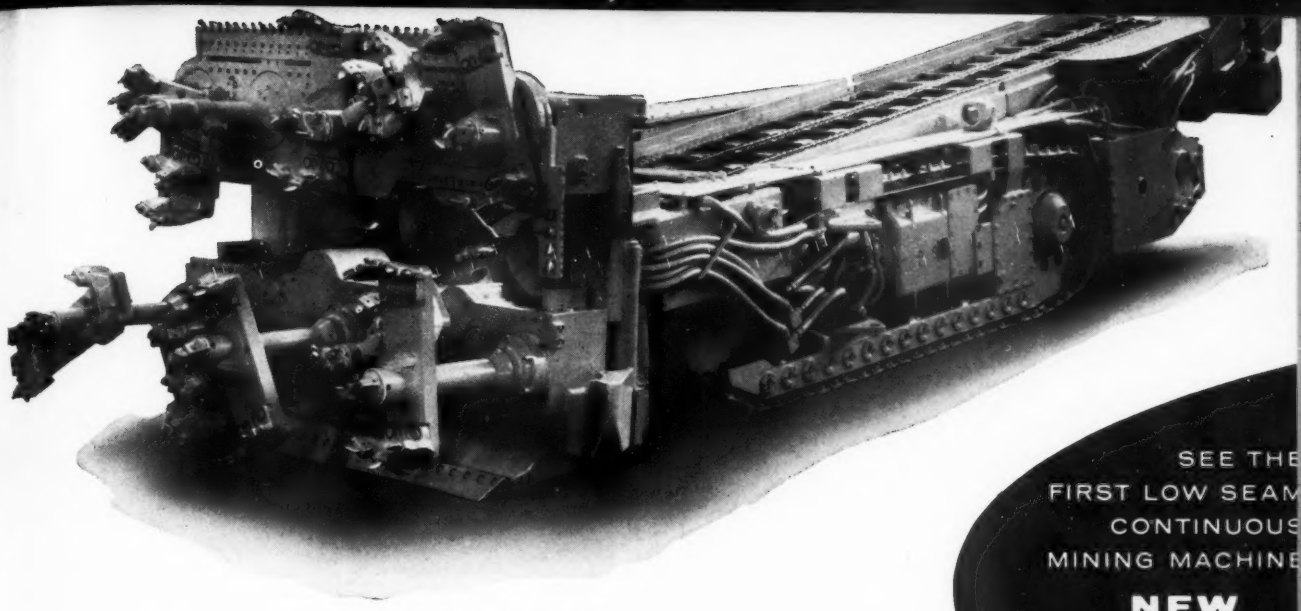
Readily accessible operating parts make adjustments and servicing easy . . . keep downtime to a minimum. And the Colmol is equipped with safety features to protect both personnel and the machine.



Molveyor trails the Colmol, sends output back in an uninterrupted stream. Trams under full load, forms flexible link between Colmol and belt line.

Loaders have power for the toughest jobs. Discharge conveyor swings 45° to either side of center and elevates to proper height for most efficient loading. Easy to maneuver.

Belt Conveyors for all purposes are available in the complete Jeffrey line. You can choose the exact head section and frame for every coal moving task.



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SEE THE
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CONTINUOUS
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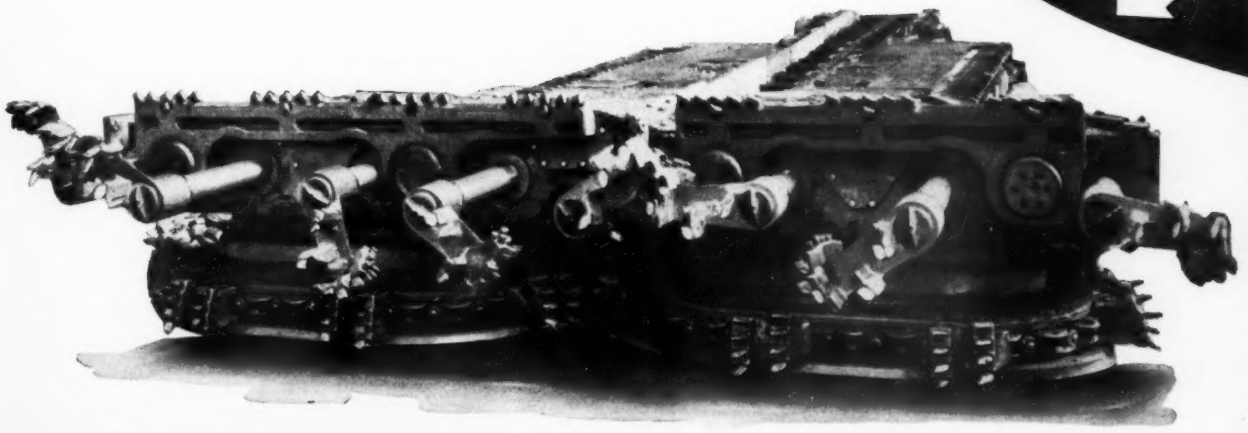
NEW
86A COLMOL



ONLY 25″ HIGH—14′7″ WIDE

Jeffrey Shuttle Cars haul big payloads. They're built for rugged service and easy maneuvering. Variable speed loading and unloading make them highly efficient.

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A 480-W dragline with a Bucyrus-Erie 14-cu. yd. bucket removes overburden at a coal mine in northwestern Kentucky.

Get the Most out of your Dragline... Use a HIGH-OUTPUT BUCYRUS ERIE BUCKET

Get the most out of your dragline by equipping it with a new Bucyrus-Erie bucket.

IT OUTPRODUCES — Full loads come easily. In digging, the weight of the bucket is concentrated to help the teeth, cutting edge and the thin "slicing-action" lip penetrate even the toughest materials quickly. The tapered basket fills full and fast. Dumping is fast and clean, helped by the smooth inside design of the basket and the extra-high arch.

IT OUTLASTS — Extra durability and high impact resistance are built into a Bucyrus-Erie bucket through the use of BECOLOY. This tough, fibrous alloy provides exceptional strength with light weight. It is readily welded and can be cut with acetylene torch — assuring low-cost field maintenance.

See your Bucyrus-Erie distributor. He will help you select the right size and type bucket for your job — light, medium or heavy, with solid or perforated basket.

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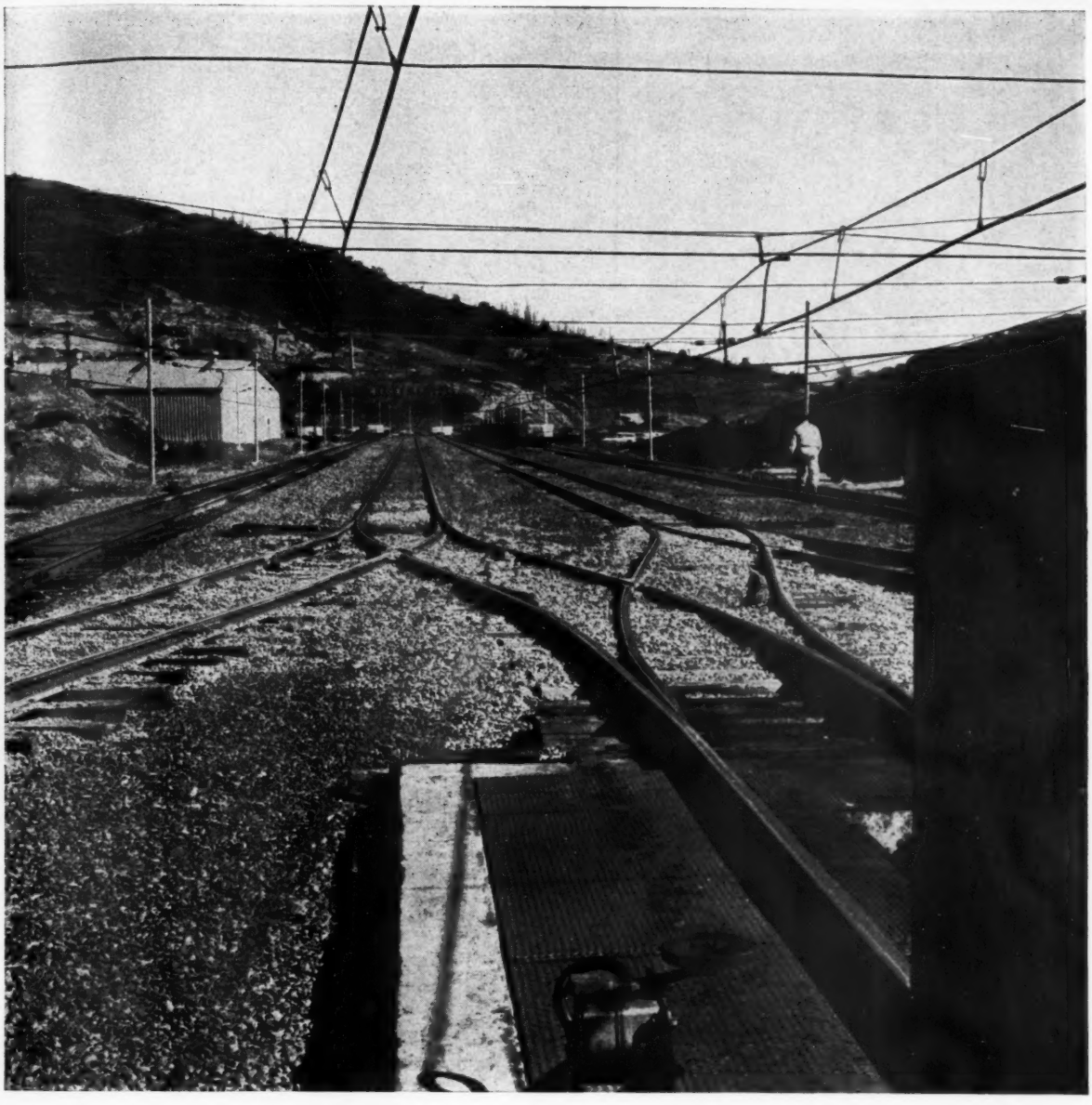
BUCYRUS-ERIE COMPANY • South Milwaukee, Wisconsin



Special trackwork that fits to a T

In this new West Virginia yard, coal trips brought up from underground are fed to a rotary dumper in a continuous string, then returned underground almost without pausing for breath.

An ingenious layout design was one of the factors in bringing this marvel of efficiency to reality. Tailor-made special trackwork was another. Bethlehem engineers cooperated with the customer in planning and designing this layout. Bethlehem shops prefabricated the trackwork, including the three diamond turnouts shown in the photograph, and a three-way switch at the discharge end of the dumper. Operations throughout the yard run smoothly as clockwork.

This is a fine example of Bethlehem engineering teamed up with forward-looking mine management to produce money-saving results. If you suspect there may be weak spots in your transportation system, our engineers would like to help you strengthen them. A phone call or note to our nearest sales office will start things moving.

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Power hydraulic controls provide fast, positive response . . . make the operator's job so easy that he's not subject to end-of-the-shift letdown. He's actually enthusiastic about pushing the machine to its high limit all shift long. "It sure is easy to operate . . . has all the power it needs," says the operator of this contour-stripping 1½-yard K-370 owned by B. G. & M. Coal Co., Manchester, Ky.

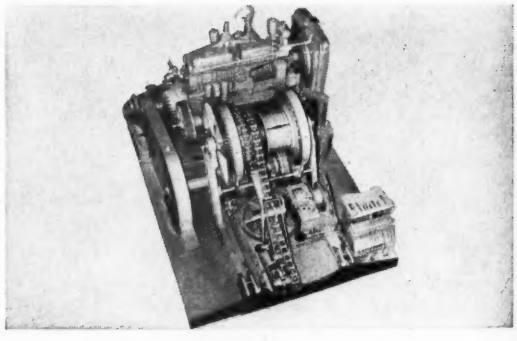
Gaining a BIG power bonus

Link-Belt Speeder shovel-cranes now deliver more usable horsepower than other machines with the same engine

Why? Because a Link-Belt Speeder is engineered for extra-structural strength to take full advantage of the engine's available horsepower and still remain well within engine manufacturers' recommended speeds. For example, Model X when run at 750 rpm develops *125 hp* . . . at 950 rpm it develops *150 hp!*

Thus, with a Link-Belt Speeder on your job you've got more usable power—extra power to sock the dipper into the bank, come up with a full load. And you've more power, to hoist, swing and travel.

And bonus horsepower is but one of many reasons why Link-Belt Speeder owners have been able to completely revise and upgrade their standards of shovel-crane performance. Why not see your Link-Belt Speeder distributor for the complete story or write Link-Belt Speeder Corporation, Cedar Rapids, Iowa.



Size and strength of components

In a Link-Belt Speeder you'll find big, extra-strength shafts, clutches, gears and other components . . . units easily able to handle the extra power the machine's engine develops. Result—more production and yet lower cost of maintenance and service . . . less downtime, more work time. 14.527

It's time to compare . . . with

LINK-BELT SPEEDER

Builders of a complete line of shovel-cranes . . . with exclusive Speed-o-Matic power hydraulic controls

Roebling
Royal Blue Wire Rope
will take **shock**
after **shock** after **shock!**

This, and the fact that Royal Blue is stronger than the strongest you have been using, has helped to make it the most widely favored rope in Roebling's history. It will work hard and last longer on *your* job. Your distributor or Roebling Sales Office will give you full information, or write: John A. Roebling's Sons Corporation, Trenton 2, New Jersey.

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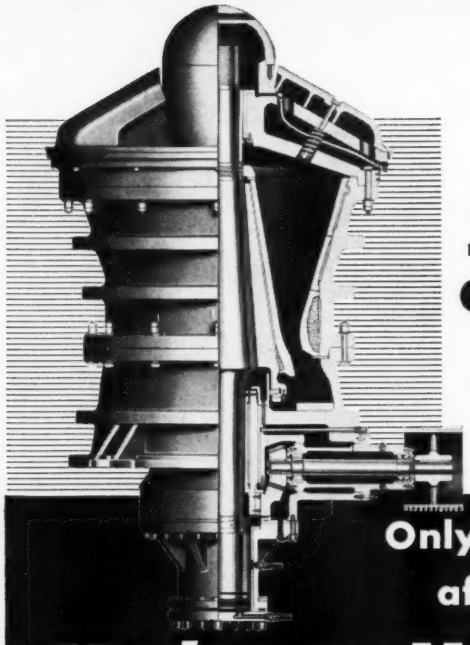

Superior

Primary and Secondary

Crusher

Bulletin O7B7870

- *Retains initial setting* by compensating for wear on crushing surfaces with one-man, one-minute *Hydroset* mechanism.
- *Entire circuit remains in balance.* Feed size to subsequent equipment remains uniform.
- *Aid in starting* is provided after crusher stops under load. *Hydroset* control reduces torque requirements. Clearing of the crushing chamber is facilitated.
- *High capacity* is the result of a unique crushing chamber design and *Hydroset* control of mainshaft position.

Only Allis-Chalmers gyratory crushers afford the many advantages of *Hydroset* Mechanism

Hydrocone

Secondary and Tertiary

Crusher

Bulletin O7B7145C

- *Wide range of settings* at the flip of a switch is made possible by the *Hydroset* mechanism.
- *Chamber is cleared* — if crusher stops under load — by merely lowering the mainshaft hydraulically with the *Hydroset* mechanism.
- *Protection against tramp iron* is provided by *Hydroset* mechanism and Automatic Reset. After tramp iron is released, crusher returns to original setting. Safe — no spring-loaded chamber.
- *Compensation for wear,* as in the primary crusher, is a one-man, one-minute operation with *Hydroset* control.

Proved all over the world —

Limestone in China, iron ore in Africa, lead zinc in South America—gravel, dolomite, cement clinker, copper, perlite, trap rock — name the product, name the location, you'll find the *Hydroset* mechanism on the job proving its tremendous profit advantage. Hundreds of Allis-Chalmers gyratory crushers, processing the widest range of products, are equipped with *Hydroset* mechanism. Even the world's largest crusher, crushing hard taconite, features the convenience and economy of this remarkable design feature.

See your Allis-Chalmers representative or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin.

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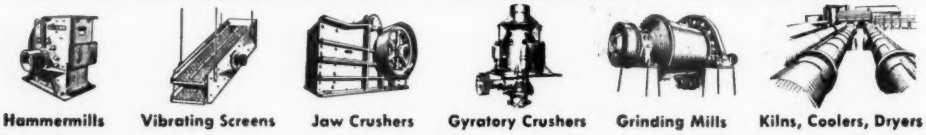

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A-5322

Announcing HI-CAP*...

New Du Pont Explosive

designed for economy in blasting operations

Hi-Cap . . . the newest addition to the Du Pont explosive family . . . will assure economy in many blasting operations.

The reason is simple. Hi-Cap answers the demand for a low-priced, cap-sensitive, water-resistant explosive with high strength for all-around shooting.

Hi-Cap is available in 12½ and 25 lb. bags for pouring into small diameter dry holes and in 23-G cartridges of 5" diameter and above.

When Hi-Cap is poured in small diameter holes, a 40% dynamite primer, 1¼x8, is recommended for detonation.

For maximum safety, charges of Hi-Cap should be detonated with Primacord in the usual manner using Du Pont MS delay connectors whenever practical. With this method of firing, you have no blasting caps on the job until the shot is ready to fire.

Notice how the 23-G cartridge is crimped to facilitate loading in the hole. The tape bail serves as a carrying handle, and also for lowering. Since no outside case is required for the 23-G cartridge, there is no packing material or debris left to clean up after the shot is loaded.

Call your Du Pont representative for more information on low-priced Hi-Cap or write: E. I. du Pont de Nemours & Company (Inc.), Explosives Department, Wilmington 98, Delaware.

**Registration applied for.*

DU PONT EXPLOSIVES

Blasting Supplies and Accessories

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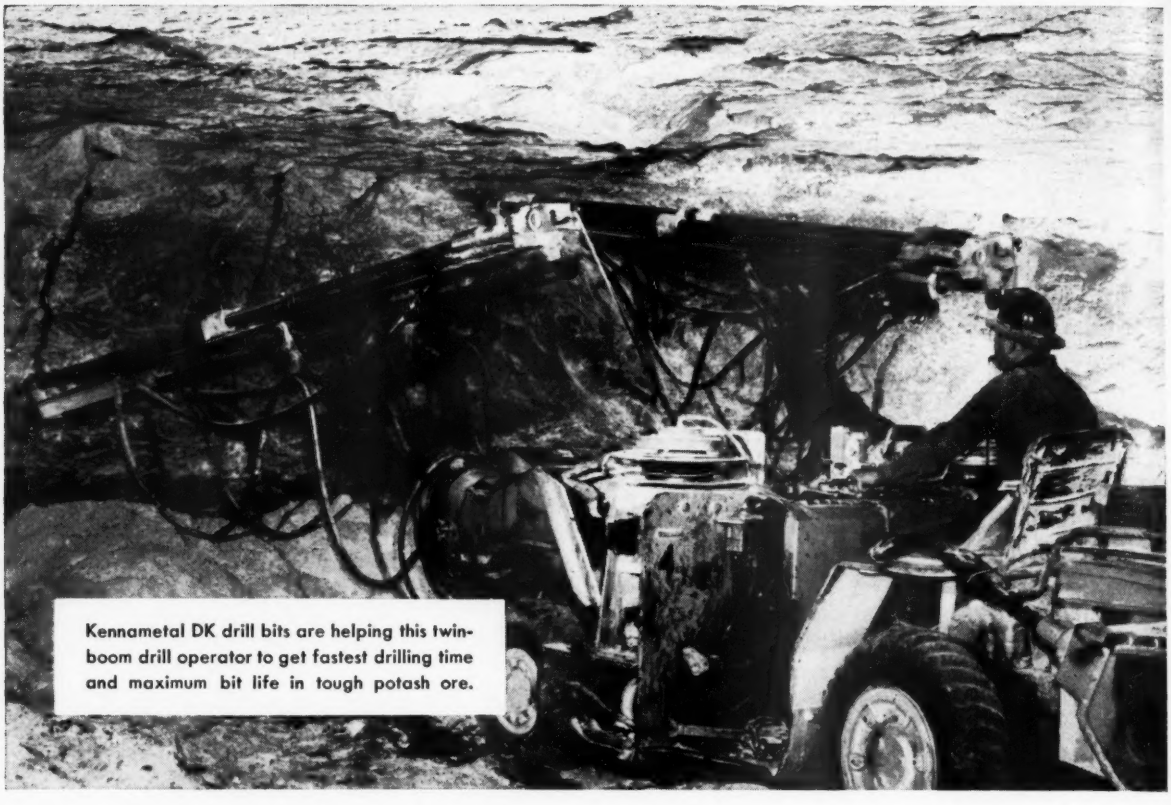


Kennametal DK drill bits are helping this twin-boom drill operator to get fastest drilling time and maximum bit life in tough potash ore.

KENNAMETAL* Bits cut tough potash ores fast . . . and cut bit maintenance costs, too

This mine outside Carlsbad, N. M., produces two types of potash ores — sylvite and langbeinite — and is a real proving ground for drilling and cutting tools. While the ores are harder than coal, the real problem comes from their toughness, which makes them hard to cut, and very hard on tools.

Tough jobs like these are a welcome challenge to Kennametal. Kennametal DK 1½" drill bits in a twin-boom driller, and Kennametal U11 and U1R cutter bits on a universal cutting machine, registered the performance records shown at the right.

The bit changing and grinding schedule is based on experience. Bits could run longer between regrindings, but increased power used, and increased drilling and cutting time, more than erase any advantage. This conservative schedule also gives more regrinds per bit.

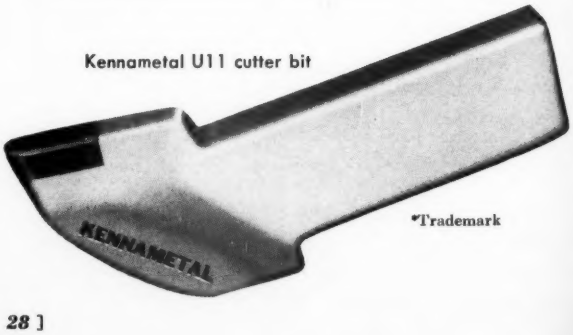
A Kennametal Representative will be glad to demonstrate how Kennametal tools can help you to step-up mine yield and step-down mining costs. Just write KENNAMETAL INC., Mining Tool Division, Bedford, Penna.

Ask about complete line of Kennametal Cutter Bits, Drill Bits, Roof Bits, Augers, Pinning Rods, Accessories.

C-3045

		Langbeinite	Sylvite
Kennametal DK 1½ Drill Bits	Places per shift	6–8	8–12
	Holes per sharpening	Three 10-ft. holes	Twenty 10-ft. holes
	Regrinds, average	10	20–25
Kennametal U 1R Cutters	Places per shift	4–6	....
	Undercuts per sharpening	Two 36-ft. cuts	....
	Regrinds	20	....
Kennametal U 11 Cutters	Places per shift	....	7–10
	Undercuts per sharpening	....	Four 36-ft. cuts
	Regrinds	....	25–30

Kennametal U11 cutter bit



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EDITORIALS

ROBERT W. VAN EVERA, Editor

JULY 1957

IN THE COAL INDUSTRY—OPTIMISM AND CAUTION

AS compared with other energy-source industries, the coal industry has experienced wide fluctuations in the demand for its product. Per capita consumption of coal had dropped in 1954 to only one-half of what it was in 1944. In 1955 and 1956 coal consumption turned upward, and there are indications of a continuing rise which have prompted forecasters to estimate the domestic market for coal by 1970 at anywhere from 485 million to 620 million tons per year, or even higher.

C. J. Potter, president of Rochester & Pittsburgh Coal Co., in discussing coal's situation at the recent convention of the National Coal Association, cautioned the industry against relying on the optimistic predictions of others—against sitting by and waiting for the predicted market to come. "A constant annual market of 500 million tons per year within the continental United States by 1970," he said, "is our necessary goal. The attainment of that goal is not impossible, but most difficult."

Potter presented graphs which traced the trends since 1940 in the energy market, comparing coal, water power, oil and petroleum products, and natural gas. The consumption of coal, on both a per capita and a total basis, shows a long-term downward trend in this 17-year period, while by contrast coal's competitors all show a rising trend. It is true that in the last two years the consumption of coal has turned upward, but at the same time the curves for the other energy sources have accelerated their rise.

In order to realize coal's objective for the coming years, it is evident that hard work and a realistic appraisal of the problems that lie ahead are needed.

The current optimism based on the past two years' reversal of the longer term trend calls for hard work and a realistic appraisal of the problems ahead if coal's objective is to be realized.

Oil and gas have made their greatest inroads into coal's markets in the industrial and retail fields. If these inroads were to continue coal would be forced out of these markets altogether—which we know is impossible, Potter said, "because off-track industrial plants, consumers living in and around the mining areas, and consumers located where oil and gas are still relatively high in price, will continue to use coal."

Similarly, the cement industry's use of coal on a per capita basis can be expected to increase in future years.

The steel industry will continue to be a reliable customer for coal. Although greater efficiencies attained in steel production have decreased the amount of coke used for each ton of pig iron, the anticipated expansion of steel-making capacity, plus new uses for coke, are expected to result in a net increase in coal consumption. The railroad and shipping industries will continue to be coal customers, though relatively small in the overall picture.

The greatest single increase in coal consumption must take place in the public utility market. The figures presented by Potter show that 57 per cent of the 500 million tons which the industry hopes to send to domestic markets in 1970 will have to be sold to utilities. And this will have to be accomplished in large part by reducing the relative share of that market now being supplied by oil and gas in the so-called competitive areas.

As to how the coal industry can assure that the recent upswing is continued and that coal obtains a fair share of its logical markets, Potter stressed that low-cost operation is imperative. "Self-help" in the form of further mechanization of coal mining can accomplish much to hold production costs down. The industry has made great strides in reducing the cost of production in thicker seams and considerable progress in seams 50 inches and under, but there is still room for significant further savings, especially in the thinner seams.

Transportation costs also must be lowered if the coal price is to be controlled and kept competitive. Ways of doing this are to interest coal's consumers in locating plants near the mine sites, to make more use of existing navigable waters and develop new waterways, and to be willing to finance coal pipeline projects to overcome the excessive rail transportation charges. In this connection Potter said, "Through our own efforts, we have reduced the price of coal at the mine, and have improved the quality of our product. We have not had cooperation from the railroads in securing reduced freight rates to protect even a small share of the energy market, and if this attitude continues, we must look to other forms of transportation if we are to maintain a stable industry."

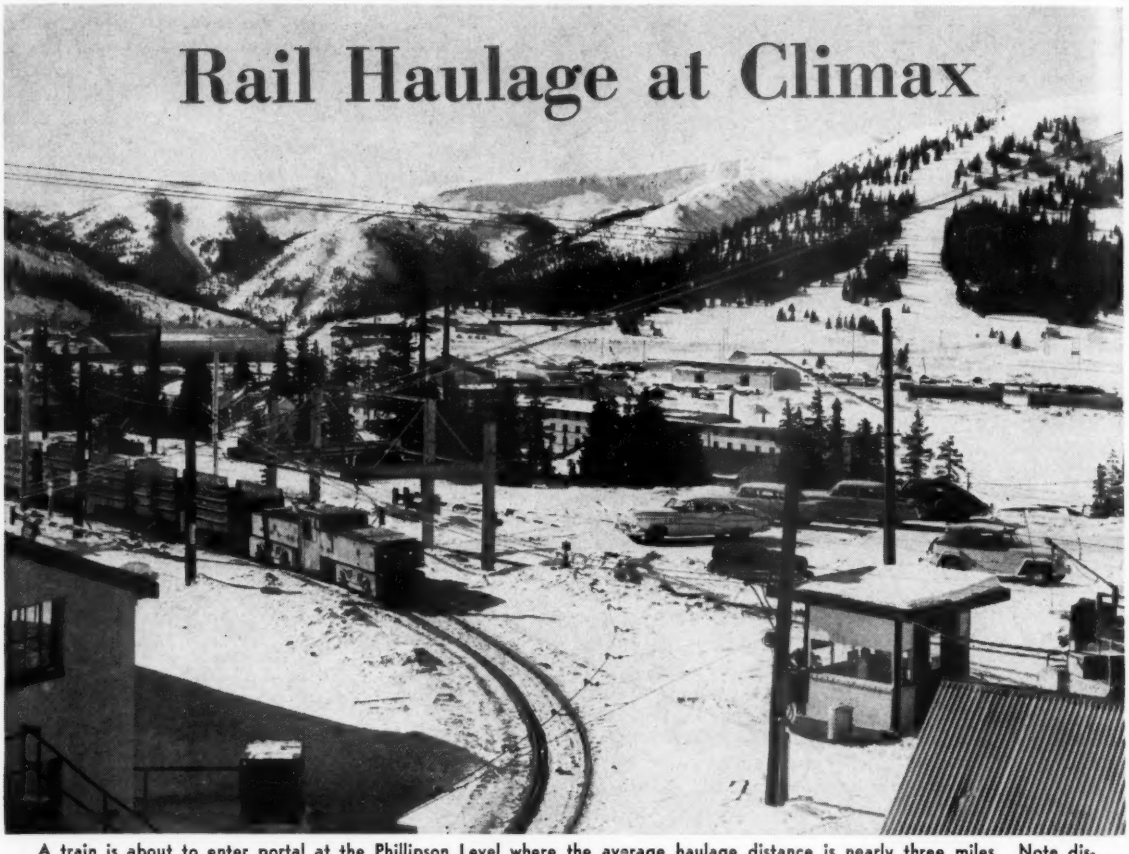
He also called for intensified research and market promotion to bring about wider acceptance and use of coal as an energy source.

To combat competition from low priced petroleum products, Potter said, "The solution is to promote legislation restricting, not only the importation of low priced residual oils and low priced crudes, but also to prevent oil and natural gas from being sold below cost." Cooperation from Government is needed, he said, not only in legislative and executive fields, but from Government agencies' giving full consideration to coal and its economy in the selection of their fuel requirements.

Concerning the evident need of the industry for large scale capital investments to finance expansion and new mines, Potter warned that "we must be careful not to greatly over-expand our facilities which can only lead to increases in cost at times when cutbacks may be necessary."

So caution comes into play with its companion, optimism—as properly it should, because in order that expansion capital for this most basic of all energy sources may be forthcoming, it must be made plain that the industry is ready to fight for fair treatment by Government, for lower cost production and transportation, and for its rightful share of the growing energy market.

Rail Haulage at Climax



A train is about to enter portal at the Phillipson Level where the average haulage distance is nearly three miles. Note dispatcher's building at the right in foreground

By C. A. CLEEVES

THE Climax Molybdenum Company's mining operation is located at an elevation of over 11,000 ft in the Rocky Mountains of Colorado. Because of the location of the mine, it has many problems which are unique to mine haulage. For the past seven years, Climax has had an average accumulative annual snowfall of 265 in. July is the only month of the year that temperatures do not normally drop below freezing, and during the last five years the maximum temperature has been 79.0° F, and the minimum a minus 30° F. Under these conditions this operation averaged nearly 30,000 tons per 24-hour day in 1955, about 32,000 tons per 24-hour day in 1956, and to date in 1957 over 34,000 tons per 24-hour day.

36 In. Gauge Railroad

Ore is hauled from two main levels at Climax; the Phillipson Level which has been in production since 1932, and the Storke Level which came into production in 1953. Thirty-six-in. gauge railroad is used throughout the operation. Ninety-lb rail is used from the dispatching points underground to the crushers and return; 65-lb rail is used in all other areas from which ore is drawn. Oregon fir ties, spaced on 18-in. centers, are used on main haulage lines. The ballast used is either 1½-in. crushed aggregate or smelter slag. Manganese frogs, and replaceable manganese switch points are used. On main lines where 90-lb rail is used and clean-up and snow are not a problem, the company has found spring frogs to have advantages over cast manganese frogs. Solenoid type automatic switchmen are used in loading areas where they are controlled by pull bottle switches. Derailers, electrically controlled by the underground dispatcher, are located at the main track intersections. It is preferable to put a train on the ground than have it wreck with another train. All derailers are followed by rerailers which are nothing more than permanent butterfly climbers. Track greasers are used to lubricate the inside flanges of the rails; this prevents excessive wear on the rail and car wheels, as well as a reduction in power consumption. On the Phillipson Level, freezing and thawing of the road bed in the adit is prevented by a forced air steam heater located at the portal. This heater warms some 30,000 cfm of air to above the freezing point. There is no serious problem on the Storke Level because we can keep the portal out-cast with warm air from the mine if desired. Wooden troughs and steel pipe flumes aid in keeping road beds dry. With the extreme snow conditions, snow sheds made with steel drift sets covered with corrugated steel sheets has been found to be the best solution. On the Storke Level there are some 6200 ft of railroad covered in this manner. On the Phillipson Level some 7500 ft of main

On February 4, 1957 the 100,000,000th ton of ore was hauled from this country's largest underground mine. Here is a description of its haulage methods and equipment, communication system, maintenance, and facilities necessary to overcome the cold weather and snow

line is kept open by snow plow. A blade type plow has given the best performance because the rotary will not clear the snow from between the rails. Snow fences are used in areas where drifting is a problem.

Formerly haulage power was supplied by motor generator sets located throughout the mine and surface, with 440 volt, a-c current delivered to the M-G sets and 275 volt, d-c current from the M-G set to the trolley lines. Today the M-G sets are grouped in one centralized location underground, with one outside set on the Storke Level and two outside sets on the Phillipson Level.

Haulage Equipment

There are 11 Atlas 19-ton four-wheel locomotives, and seven newer General Electric 20-ton swivel-truck eight-wheel locomotives, in use on ore haulage. In addition some 20 service motors are connected with the operation. The locomotives and the first four to six cars are equipped with air brakes. Also, the General Electric locomotives have dynamic electric brakes. At present the company is experimenting with Westinghouse quick-action automatic air brake equipment on one of its trains. The air brake, as used on railroads, is so constructed that the brake will be applied automatically in case of an accident which causes air to escape from the system.

Climax uses Granby type cars rated from 190-200 cu ft in capacity. On the Storke Level the car factor runs about nine tons per car, whereas the Phillipson Level runs about eight tons per car. The difference is caused by greater back clearance on the Storke Level. A "stool pigeon" is necessary to protect adit timber from high rocks on the Phillipson Level. Car maintenance and inspection is taken care of by a mechanic located at the crusher on day shift. It is his responsibility to repair any cars he can and remove from trains any cars which require major repairs. Basically, all repairs on the haulage equipment are done on day shift. This leaves the night shifts free to haul ore with little or no interference.

The ore from the Phillipson Level is dumped into three bins over which are located moveable dump blocks controlled by electrically driven eccentrics. Each bin holds from one to three trains of ore, depending upon weather conditions. On the Storke Level the ore is dumped directly into a 60-in. gyratory crusher which crushes the ore to seven in. The ore is then stored in a coarse ore bin which has a capacity of 20 trains. A pneumatic ram type of car cleaner with a toothed bar on the piston rod is used to remove packed muck in the cars. Recently there has been installed an air activated car-spotter which has reduced maintenance on these cleaners considerably.

Clean up is a very important factor in the handling of large tonnage. In the loading areas the men are expected to use shovels to keep their working areas free of small spills. When it is necessary to clean up large spills or an accumulation of ore, an E-40 Eimco Mucking Machine is available which works directly off the trolley system. The clean up crew which operates this equipment works under our production foreman, thus tying production and clean up very closely.

Communications

Communications for a haulage system as large as Climax' is essential. Three independent systems are used as aids to the production crew supervisor. A Bell telephone system connects our inside dispatcher located at Number One Switch with all the important stations in the camp and connects through a PBX board with telephone lines off the camp site. A mine telephone system gives Number One Switch a line to all important underground stations. "Trolleyphones" operating with trolley power and the trolley as a carrier are installed on all of our haulage locomotives and most of our service locomotives. Our

(*Continued on page* 39)

Charles A. Cleeves, Assistant Mine Supt., Climax Molybdenum Co., received his training in Mining Engineering from the University of California. Prior to the war he worked for Consolidated Coppermines, Kimberly, Nev.; U. S. Vanadium Corp., Bishop, Calif., and Climax Molybdenum Co., Climax, Colo.

After serving in the U. S. Navy for two years, Cleeves returned to Climax as a shifter in the mine department for concrete, development, and repair crews. He has subsequently worked for Riverside Cement Co., Crestmore, Calif., as a miner; E. J. Longyear Co., Minneapolis, Minn., as project superintendent in the mine contracting department; C. D. Wailes Corp., Sun Valley, Calif., as production superintendent for its precast concrete division. Since 1954 Cleeves has worked for Climax as shift boss, foreman, general foreman, and assistant mine superintendent.

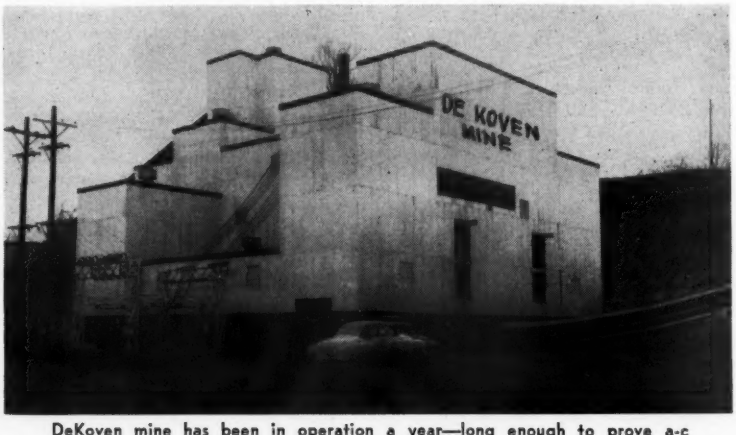
THE DEKOVEN MINE - - -

Features all belt haulage and a-c power underground

By COURTNEY S. QUIREY, SR.

Superintendent, DeKoven Mine, Pittsburg and Midway Coal Mining Co.

THE Pittsburg & Midway Coal Mining Company's new DeKoven mine, located on the Ohio River near Sturgis, Ky., began production in the fall of 1956. The latest developments in modern mine equipment and procedures were utilized in the design and development of the underground operations and the coal handling and preparation facilities. Prime feature of the underground operation is the use of a-c power. Keynote of the overall operation is flexibility. Facilities for the handling and storage of raw coal and washed coal make it possible to operate the mine, the preparation plant and the loading of washed coal independently. Although designed primarily for river transportation, facilities have also been provided for loading railroad cars.



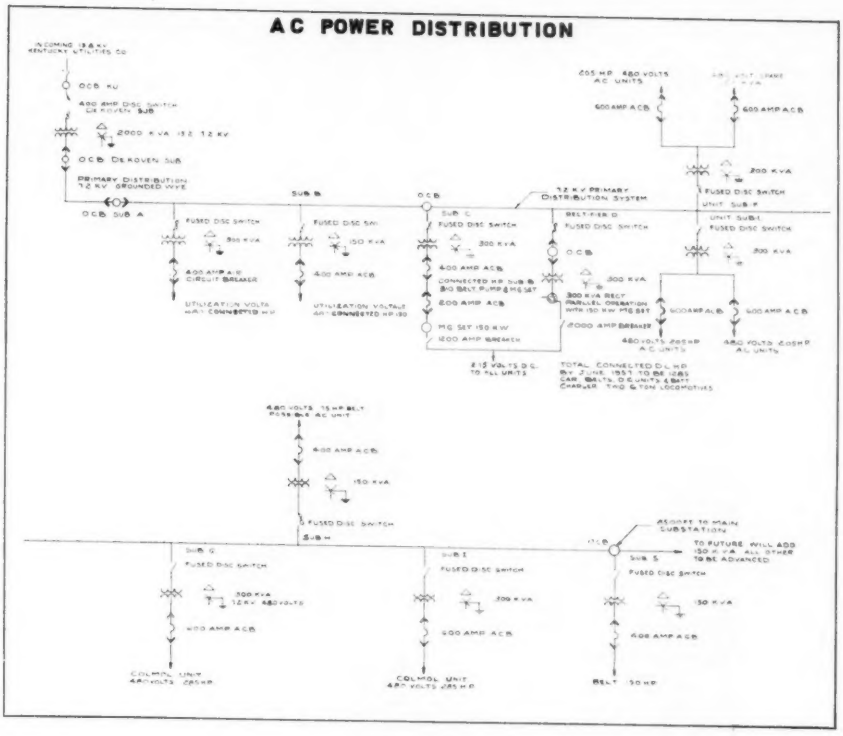
DeKoven mine has been in operation a year—long enough to prove a-c power is more economical and efficient than d-c power

Equipment Used

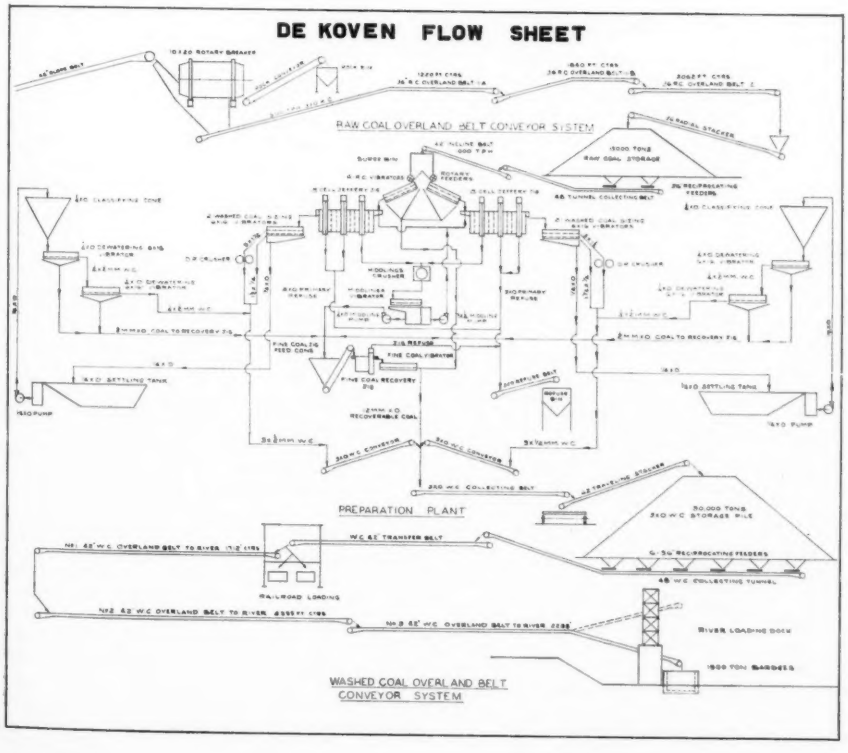
Conventional room and pillar mining is practiced underground. Equipment consists of four conventional units. Sometime in the future two continuous miners will be installed. The four permissible conventional units consist of:

- **Four RBD 15 Joy roof Drills**
- **Four Goodman Universal, rubber tire mounted, Type 2410 cutting machines**
- **Four Jeffrey Type 56FHR, rubber tired mounted, coal drills**
- **Four Goodman Type 966-C tractor tread loaders**
- **Ten Goodman Type 580 cable reel shuttle cars**

Goodman Manufacturing Co. was very cooperative in the design and development of the a-c equipment we requested. All machines underground operate on 3 phase, 60 cycle, 440/v a-c power. Each cutting machine is equipped with two permissible type a-c motors—one is a 60-hp cutting motor and the other a 35-hp pump motor. This machine has an overall height of 40½ in. and a 9-ft cutter


A C POWER DISTRIBUTION
INCOMING 13.8 KV KENTUCKY UTILITIES CO
OCB 13 KV
400 AMP DISC SWITCH DE KOVEN SUB
2000 KVA 13.2 12 KV
OCB DE KOVEN SUB
PRIMARY DISTRIBUTION 12 KV GROUNDED WYE
OCB SUB A
SUB B
OCB
SUB C
12 KV PRIMARY DISTRIBUTION SYSTEM
205 HP 480 VOLTS A.C. UNITS
600 AMP A.C.B.
600 AMP A.C.B.
300 KVA
FUSED DISC SWITCH
UNIT SUB F
UNIT SUB E
FUSED DISC SWITCH
300 KVA
RECTIFIER D
FUSED DISC SWITCH
OCB
300 KVA
FUSED DISC SWITCH
300 KVA
150 KVA
400 AMP A.C.B.
400 AMP A.C.B.
UTILIZATION VOLTS (ALL CONNECTED H.P.)
UTILIZATION VOLTS (ALL CONNECTED H.P.)
CONNECTED H.P. SUB B, BIG BELT PUMP & MG SET
600 AMP A.C.B.
MG SET 150 K.W. 1200 AMP BREAKER
300 K.V.A. RECT. PARALLEL OPERATION WITH 150 K.W. MG SET
2000 AMP BREAKER
600 AMP A.C.B.
600 AMP A.C.B.
480 VOLTS 205 HP A.C. UNITS
480 VOLTS 205 H.P. A.C. UNITS
275 VOLTS D.C. TO ALL UNITS
TOTAL CONNECTED D.C. H.P. BY JUNE 1957 TO BE 1085 CAR MOTORS, D.C. UNITS & BATT CHARGER TWO 6 TON LOCOMOTIVES
480 VOLTS 15 HP BELT PUSH BUTTON A.C. UNIT
400 AMP A.C.B.
150 KVA
FUSED DISC SWITCH
SUB H
SUB G
FUSED DISC SWITCH
300 KVA 12 KV 480 VOLTS
400 AMP A.C.B.
COLMOL UNIT 480 VOLTS 205 H.P.
SUB I
FUSED DISC SWITCH
300 KVA
600 AMP A.C.B.
COLMOL UNIT 480 VOLTS 205 H.P.
OCB
SUB S
FUSED DISC SWITCH
150 KVA
400 AMP A.C.B.
BELT 150 HP
RISER TO MAIN SUBSTATION
TO FUTURE WILL ADD 150 K.V.A. ALL OTHER TO BE ADVANCED

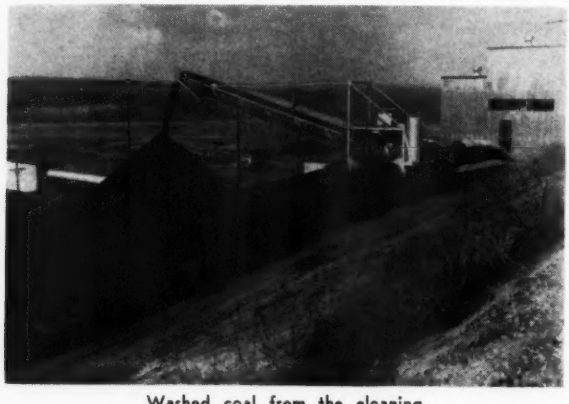
Power is purchased at 7200 v and distributed to five a-c substations and one d-c rectifier


DE KOVEN FLOW SHEET
RAW COAL OVERLAND BELT CONVEYOR SYSTEM
PREPARATION PLANT
WASHED COAL OVERLAND BELT CONVEYOR SYSTEM

Designed to handle 1000 tph of coal, the preparation plant actually contains two identical washing circuits with a capacity of 500 tph each

bar and weighs approximately 26,000 lb. All functions of the machine, with the exception of cutting, are hydraulically operated by either hydraulic motors or cylinders.

Loading machines are equipped with two 20-hp motors on each side of the loading head, furnishing power to the eccentric type gathering arms and to the conveyor chain. Each tractor-tread is driven by a 20-hp a-c motor through a transmission. The forward and reverse movement of each tread is controlled by reversing multiple disc clutches which are engaged by double acting hydraulic cylinders. Two hydraulic pumps supply pressure for swinging the discharge end and elevating both ends of the conveyor. Loading capacity is six to ten tons per minute, and the overall height is 34 in., with a coal line height of 22½ in.



Washed coal from the cleaning plant is stored adjacent to the plant. Washed coal storage has advantages similar to those of raw coal storage

Advantages of A-C

Although standard conventional underground mining system and procedures are used, a radical departure was made from the more or less general practice of using d-c power underground. In recent years the rapid progress in the development of underground equipment to make a-c practical, has been brought about through the adoption of hydraulic power. After a careful study of many electrical distribution systems in use, both d-c and a-c, and the underground equipment available for d-c operation, it was decided an a-c system could be developed that would add efficiency and economy to the underground mining operations. It was determined that a-c power offered the following advantages:

1. Capital investment is much lower. A-c units may be installed for approximately one-third the cost of comparable d-c equipment.
2. Unit sub-stations are smaller and easier to move.
3. A-c power cables are smaller and more flexible.
4. Safety devices are more sensitive.
5. Maintenance on a-c equipment is lower.
6. Power voltage is constant.

Constant voltage is required to maintain operation of a-c powered equipment. If the voltage drops a-c equipment won't operate, making it necessary to find and repair the trouble. Under similar circumstances, d-c equipment will continue to operate, but at a lower efficiency, and in many operations the tendency is to keep going as long as the machine will run instead of stopping and making the necessary repairs to build the voltage back up to maximum. This not only results in reduced productivity but also in extremely expensive maintenance costs because of the damage to motors from heat and arcing. To operate at maximum efficiency on either a-c or d-c the voltage must be kept up to maximum. There is more incentive to maintain maximum voltage for a-c powered equipment because not to do so means the equipment just won't operate. Then too, a-c transformers are much smaller and easier to keep up to working face.

An a-c system also makes it possible to provide maximum safety protection from mine fires. Portable mine type transformers can be kept close enough to the work face so that ground protection is efficient.

Power System Described

The a-c electrical distribution system in use is as follows: Power enters the mine at 7200 through a 15,000-v 4/0 mine feeder cable. It is distributed to five a-c sub-stations and one d-c rectifier. The first and third stations are equipped with a bank of three subway type 100 kva, 7.2/480 Pyranol filled transformers. The second station is equipped with a 150 kva, 7.2/480 subway type transformer. The other two stations consist of one 300 kva, 7.2/480, three phase portable mine type transformer equipped with two 600-amp breakers with insulated ground resistor and selective tripping. The rectifier station is a 300 kw, 7.2/275 d-c and is in parallel operation with a 150 kw m.g. set. All transformers are wye connected with current limiting resistor in the neutral and ground trip circuit breaker. The breaker will trip with a ground current of 2½ amp.

As the mine is developed the electrical distribution system will be extended. Two 300 kva, 7.2/480 substations will be established to handle the two continuous miners that will eventually be placed in operation and two 150 kva, 7.2/480 stations will be established to handle the additional belt system and other equipment.

Complete Conveyor Haulage

Coal is transported to the surface by means of a conventional belt conveying system consisting of four units as follows: a slope belt, the main north belt, an east cross entry belt and a north panel entry belt. The panel belts are 36 in. wide. All other belts are 42 in. wide. Coal is discharged from the main north belt into an underground surge hopper. Upper and lower limit switches operate the feeder or stop the mine belts as required. A reciprocating feeder supplies coal to the 42-in. main slope belt which operates at a speed of 400 fpm. The slope belt is 1100 ft long, center to center, and is inclined 18°.

Raw coal is discharged on the surface into a 10 x 20 McNally-Pittsburg rotary breaker equipped with three-in. screen plates. Minus three in. is fed directly to the first section of the 36-in. overland belt. It operates at a speed of 500 fpm. Rock and material rejected by the breaker is transported by truck to the refuse pile. Location of the rotary breaker at the end of the slope belt offers several advantages. Coal reduced to minus three in. can be transported easier and, since the breaker removes all the rock, slate and other impurities from the coal over three in. in size, it eliminates transporting a portion of the impurities to the preparation plant.

The raw coal overland belt line is 6122 ft long and consists of three sections of 1220 ft, 1840 ft and 3062 ft respectively. The line was installed over rough terrain which required considerable engineering.

It follows the contour of the terrain with some grading being necessary to not exceed a maximum incline of 18°. A maximum radius was maintained on all curve sections. The system has step-starting controls which are interlocked electrically, thus protecting against slippage or stoppage.

To protect the belt from edge wear when misalignment takes place, the return idlers are six in. wider than the carrying idlers. The first section of the raw coal belt is equipped with a belt scale to determine the tonnage going to raw coal storage.

Coal Storage

The raw coal belt system discharges onto a 36-in. radial stacker which, in turn, discharges to the raw coal storage pile designed to handle a maximum of 15,000 tons. The choice of tipple location made it possible to locate the raw coal storage on level ground adjacent to, and considerably above, the ground elevation of the preparation plant and also to locate the radial stacker 40 ft above the storage pile base. Raw coal storage has several advantages.

1. It makes possible greater plant and mine flexibility.
2. It permits the mine to continue to produce when the preparation plant is down for repairs or some emergency shut down.
3. It also provides a constant rate of feed to the preparation plant so the plant can operate at maximum efficiency.

Coal from storage is fed by dual 36-in. variable speed reciprocating feeders located in a tunnel beneath the storage pile onto a 48-in. collecting belt which discharges onto the main 42-in. incline belt. A belt scale is provided on the incline belt for determining the weight of feed to the plant. From the incline belt, coal is discharged into a 50-ton surge hopper located at the top of the plant.

Coal Preparation

The preparation plant, which was designed to handle 1000 tons of coal per hour, has the unique feature of being split down the middle into two complete identical washing circuits of 500-tph capacity. These can be operated in unison or independently as separate units. The advantages of this design are:

1. Continuing production at half capacity even during major breakdowns.
2. A small parts inventory due to interchangeability.

Coal is drawn out on each side of the surge hopper by rotary vane feeders which feed onto four 6 by 16-ft incline vibrating screens. The advantage of the screen is that minus ¼-in. material, or finer, may be screened out ahead of the washing units and blended in with the washed coal product. Veil sheets are provided at the screens so the fines can go directly to the washing circuit when screening is not desired.

Raw coal discharge from the vibrating screens is sluiced to two 8 cell 84 in. wide Jeffrey Baum jigs. Clean coal from the jig is discharged onto four

Raw coal is transported 6122 ft from the mine mouth to the preparation plant by a 36-in. conveyor over rough terrain

6 by 16-ft double deck Allis-Chalmers Lohead classifying screens equipped with 1½-in. woven wire screen on the top deck and ¼-in. stainless steel screen on the bottom deck. The 1½ by ¼-in. coal is blended with the washed coal product. The plus 1½-in. coal which passes over the top deck can either be blended with the 1½ by ¼-in. coal or crushed to 1½ in. or finer in two 36 x 60 McNally Gearomatic Stoker Crushers provided at the end of each pair of screens.

The ¼-in. by 0 material from screens goes direct to two large fine coal settling tanks from which it is pumped to a hydraulic classifying cone and classification made at 60 mesh. The ¼-in. by 60 mesh coal is drawn from the bottom of the cone onto two 6 by 16 ft Robbins Dewaterizers in tandem and equipped with ½-mm stainless steel deck. The ¼-in. by ½-mm coal from the screens is blended with the washed coal product.

The ½-mm by 0 underflow from screens plus the ¼-in by 0 crushed middlings from the two final middlings elevators of the jigs go to a second hydraulic classifying cone. Underflow from this cone is conveyed to two new fine coal jigs which were developed by Elmer H. Citron, preparation engineer, The Pittsburg and Midway Coal Mining Co., and manufactured by the Ore Reclamation Company. The product from the jigs passes over a 5 by 14-ft Robbins dewaterizer equipped with a ¼-mm stainless steel deck. Coal passing over screen is blended with clean coal and the coal passing through the screens, plus the 60-mesh by 0 overflow from all of the hydraulic classifying cones, is pumped to two banks of 14-in. Heyl-Patterson cyclones. There are 10 cyclones in each bank.

Underflow from the cyclones goes to two 6 by 16-ft A-C Lohead screens equipped with ¼-mm deck and the material passing over the screen goes directly to the refuse bin. Underflow from the screen goes to a sludge pond. The ¼-in. crushed middlings from the two final middlings elevators is recirculated and the refuse from the primary elevators of the jigs is conveyed to the truck refuse bin.

Loading Facilities

All of the washed coal from the preparation plant is collected on a 42-in. trunk line belt and discharged onto a traveling stacker adjacent to the plant which discharges to a washed coal storage pile. Storage capacity is 30,000 tons. The storage pile base is built on an incline which permits the water to drain from the coal, thus reducing surface moisture.

Washed coal storage has advantages similar to those of raw coal storage. It makes it possible to store washed coal on second shift operations or on days when coal is not being shipped and, due to the base construction, it also helps to reduce the surface moisture of the coal. For maximum reduction of moisture, coal should be stored in cones or in one long pile above the ground with proper drainage provided. A traveling stacker makes the latter procedure possible.

The washed coal draw-out system is similar to the raw coal system. Dual reciprocating feeders feed the coal onto a 48-in. collecting belt. The coal is discharged onto a 42-in. belt provided with a belt scale and is conveyed to either the railroad loading station or to the river overland belt system by opening or closing a gate. The overland belt system consists of three sections of 42-in. belt constructed 30 ft above the ground and operating at 550 fpm. It has a capacity of 1000 tph. Overall length of this system is 6626 ft.

River facilities consist of 11 cells. Barge shifters are provided on each machinery cell for handling barges for loading and docking. The loading boom is part of the third section of the belt line.

Summary

Since July 1956, when production was started, operating experience has proven the performance of A.C. power underground. Installation, operating and maintenance cost compared to comparable mines operating on D.C. power have shown A.C. to be more economical and efficient.

The underground belt system has been operating satisfactorily and the overland belt system, with the raw and washed coal storage, permits a flexibility of operations that adds to the efficiency of the overall operation.

Churn drilling, an underground exploratory program and excavation of a preliminary pit all helped in designing Anaconda's new open pit mine in the Butte district

Development and Planning of the BERKELEY PIT

By EDWARD P. SHEA

DISCOVERIES made in certain parts of the Greater Butte Project development program, together with geological records and old incomplete sampling data on file in the geological department of The Anaconda Company at Butte, Mont., indicated the existence of a secondarily enriched sulphide ore body on the Butte Hill near enough to the surface for possible mining by open pit methods. Therefore, a decision was made in March, 1952, to drive crosscuts on two horizons in this secondarily enriched zone to test the possibilities. Crosscuts were driven on the 600 level of the Rarus and Kelley mines, 300 of the West Colusa and 200 of the Pennsylvania with sufficient encouragement to warrant additional development. Because most of the upper level workings in the area are inaccessible and crosscutting underground would be slow and expensive, a decision was made to churn drill holes from the surface. During 1953 a contractor drilled 25 holes and demonstrated that churn drill sampling in this area in Butte could be considered reliable. Incomplete data at the end of 1953 indicated an orebody containing at least 100,000,000 tons averaging 0.75 percent copper, and a program of churn drilling on a 200 ft grid was planned. Another contract was let, drilling was resumed in April 1954, and now 138 holes aggregating 80,556 ft have been drilled west of the Meaderville highway and north of the Butte-Helena highway. This drilling verified the original estimate.

A preliminary pit, known as the Berkeley Pit, was started in March 1955. The plan was to expose the top 100 ft. of sulphide ore beneath the leached capping. The ore shipped therefrom was sampled and treated separately at Anaconda to check the churn drill data, and metallurgical tests were made to determine the most effective treatment for maximum recovery of contained metals. Also, valuable information was gained on mining methods, bench slopes, powder requirements and the like.

Underground Crosscutting

Crosscuts were advanced into the possible orebody on the 200 level of the Pennsylvania, 300 of the West Colusa and 600 of the Kelley and Rarus mines. A total of 6138 ft of work was driven; large sack hand cut samples, mine car samples and, where possible, shipment samples were taken.

A total of 21,179 dry tons of material were sent to the Washoe Sampler, The Anaconda Company's custom sampling plant located in Butte. This material, all from development crosscuts, averaged 0.83 percent copper, 0.22 oz silver and 0.002 oz gold.

Preliminary Churn Drilling

A decision was made to drill at least four holes totaling approximately 2000 ft to determine if churn drilling would be applicable to this type of deposit. Crosscuts, mentioned above, had been driven previously and the Pennsylvania B276 crosscut was located directly over the Rarus B607 crosscut. The first three holes were drilled down through the crosscuts to check the crosscut data. Hole No. 1 cut ore averaging 0.57 percent copper in a block averaging, according to crosscut shipment samples, 0.59 percent copper. Holes No. 2 and No. 3 were drilled along the same line 400 ft apart and developed a block of ore averaging 1.47 percent copper according to drill data, and the crosscut shipment samples showed the same block to average 0.80 percent copper. Hole No. 2 cut material averaging 0.89 percent copper, but Hole No. 3 followed a small, steep-dipping veinlet and the sludge samples were too high, averaging 2.01 percent copper for a depth of 340 ft. Raises were

driven along the holes to further check the results.

After the first few holes were drilled it was proved that the results were usable, providing the holes were properly placed. Sufficient geological data were available in the area in that all the underground workings were mapped and this data was used to plan additional drilling. Holes were placed to avoid steep-dipping veins and gobs. By the end of 1953, 22 holes were completed and the deposit was conclusively demonstrated to extend east to the Meaderville highway. The 22 holes average 582 ft deep and have cut ore averaging 238 ft thick and 1.03 percent copper beneath 259 ft of overburden. An average, omitting two doubtful holes which followed veins and one in waste, shows 254 ft of material averaging 0.83 percent copper beneath 242 ft of overburden waste.

Using the available incomplete data in crosscuts, raises and churn drill holes and applying known geological information, another estimate of the indicated orebody was made on January 1, 1954. The area considered adjoins the Pennsylvania No. 1 vein on the south side and extends west from the Meaderville highway 4600 ft into the Butte Hill in the vicinity of the Mt. View shaft. Additional ore is known east of the Meaderville road, but this ore is not included in the present estimate. The total ore west of the Meaderville road, is indicated by incomplete information on January 1954 aggregated 100,000,000 tons averaging 0.80 percent copper, with additional ore beyond the area being considered. Results showed that ore extended beyond this originally considered area and, therefore, another 76 holes were recommended.

Raising

Four raises aggregating 210 ft, driven along the holes to check the churn drill assay results, demonstrated that churn drills will obtain satisfactory samples in an area of flat-dipping veins or in mineralized granite, but churn drill results are not satisfactory where the vein structures are steep. A policy was adopted whereby holes were planned to miss the important steep-dipping veins and if unexpected vein mineralization appeared in the cuttings, the results were discounted before being used. The method of discounting is explained below.

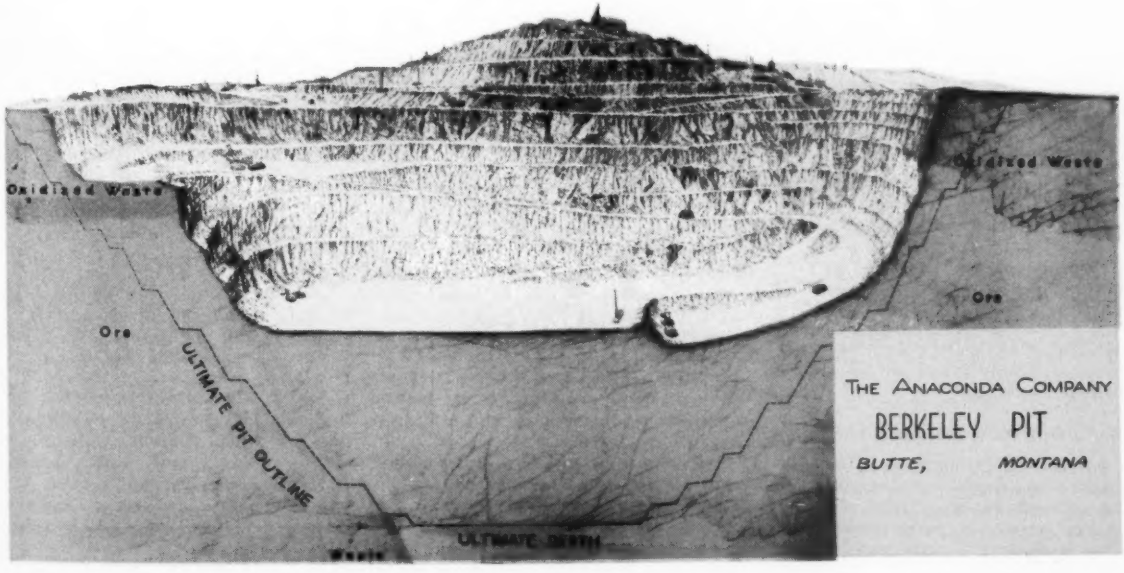
Comparison of Samples

When the second series of churn drill holes were started, the first holes drilled were to obtain information to compare churn drill results with crosscut data. In the early development of the area two crosscuts, one directly over the other, were driven across the orebody and all material excavated therein was shipped to the Washoe Sampler for sampling. One crosscut on the Pennsylvania 200 level is approximately 90 ft below the top of the ore, and the other on the Rarus 600 level, at 115 ft below, is 90 ft above the bottom of the ore. These crosscuts were spaced so as to get an accurate sample, and the shipments therefrom represent the true grade of the cross section. Ten churn drill holes spaced 200 ft apart were drilled from the surface down through the crosscuts to sample the same section and determine the accuracy of the churn drill results. A comparison of the two types of samples shows the churn drill results to be somewhat higher than the crosscut sample data.

Edward P. Shea, in charge of Butte Geological Dept., the Anaconda Co., Butte, Mont., graduated from the Montana School of Mines in 1922 with a degree of Mining Engineer, and was awarded the professional degree of Geological Engineer from the same institution in 1952. Joining the staff of The

Anaconda Company as an engineer in 1924, Shea was promoted to the geological department in 1926 as a geologist and on January 1, 1952, was made head of the department. With this background, he is particularly well qualified to write this report on the Berkeley Pit project.

Assuming the shipment sample averages to be correct, the churn drill assay results should be discounted before being used in estimates. However, the difference between churn drill and crosscut shipment samples was determined to be insignificant in the low grade material, but in the high grade ore, the churn drill results are high compared to crosscut shipment. Therefore, high grade churn drill returns had to be discounted, and to determine the amount of reduction and the method of procedure, many different calculations and comparisons were made. In one, the original churn drill samples were compared to the crosscut data; in



another, all samples assaying above 1.3 percent copper were reduced to 1.3 percent copper; in the third, all above 1.1 percent copper were lowered to 1.1 percent copper, and in the fourth, everything above 1.0 percent copper was cut to 1.0 percent copper.

Grade estimates of a block of ground extending from eight ft above to eight ft below the crosscuts using the above adjustments are shown in Table I.

A similar calculation was made to obtain the grade of the total cross section, including all waste regardless of width or height between ore areas using the same reductions. Results are given in Table II.

The above estimate assumes that no waste will be sorted in a shovel operation. If a pit is set up with benches 25 ft high some selective mining is possible and all segments of waste at least 15 ft thick should not be included in the ore. Calculations were made to show the grade of the ore only, eliminating waste exceeding 15 ft. Table III shows the results of these calculations in which the ore-waste cutoff is 0.5 percent copper.

The estimate in which the churn drill samples above 1.1 percent copper were reduced to 1.1 percent copper checks approximately the crosscut shipment samples. However, all assays above 1.1 percent copper were reduced to 1.1 percent regardless if the material was vein or disseminated copper sulphide in granite. The comparison shows the drill assay to average 0.80 percent copper and the crosscut samples to be 0.83 percent. Because the churn drills were low in this procedure, another estimate was made in which each hole was studied separately, considering geology as shown on the cross sections, and only the veins were reduced to 1.1 percent copper. Granite, with disseminated sulphides, was not reduced. This showed the average according to churn drill results to be 0.82 percent copper, a very close check on the 0.83 percent copper average obtained from the crosscut shipment samples.

A review of the above facts revealed the churn drill results must be reduced to check crosscut shipment data. Each hole must be studied separately, and all segments in veins assaying above 1.1 percent copper must be reduced to 1.1 percent copper. Original unchanged assays are to be used for all other material including country rock with disseminated copper-bearing material. Churn drill data were reduced accordingly and an ore reserve estimate was made.

TABLE I. PERCENT COPPER

XC No.	Length in Ft	XC Shipment Samples	Original Churn Drill Samples	Churn Drill Samples Reduced to 1.3% Cu Max.	1.1% Cu Max.	1.0% Cu Max.
B276	1,386	.81	1.54*	.92	.84	.79
B607	1,156	.62	.66	.65	.65	.65
TOTAL	2,542	.72	1.13*	.79	.75	.72

* Includes two holes which are in veins at the 200 horizon.

TABLE II

Crosscut Shipment Samples	Original Churn Drill Samples	Churn Drill Samples Reduced to 1.3% Cu Max.	1.1% Cu Max.	1.0% Cu Max.
.79	1.17	.83	.78	.75

TABLE III

Crosscut Shipment Samples	Original Churn Drill Samples	Churn Drill Samples Reduced to 1.3% Cu Max.	1.1% Cu Max.
.83	1.17	.90	.80

Churn Drill Hole Sampling Procedure

A standard drill hole sampling procedure was adopted to meet conditions encountered in the Butte District. General practice is to commence sampling each hole approximately 25 ft above the anticipated sulphide zone. The leached capping is barren and sampling is unnecessary.

The upper portion of each hole is drilled with a 12 in. diameter or larger bit to permit 10¾ in. casing to be installed through the leached capping, and approximately ten ft into the sulphide zone, thus eliminating contamination of the sulphide samples by caving of the oxidized material above. No casing is run until the sulphide zone is reached unless necessitated by caving ground. Drilling in the sulphide zone is normally done with a nine in. diameter bit, but when caving of the sulphide material or old gobs occur, 8⅝ in. casing is run and carried to solid formation and the hole continued with a seven in. diameter bit. When drilling in sulphide material, water for drilling is always lowered to the bottom of the hole with the bailer to prevent washing material from the sides of the hole.

Where metallurgical research work is necessary, two-gal samples are taken and split in half, one portion is retained in a sealed one-gal glass jug and sent to the Anaconda Reduction Works research department for testing. The remaining half of the sample is retained in a waxed paper carton and sent to the assay office for total copper, oxide copper, silver and specific gravity determination.

Graphic logs on a scale of one in. to ten ft are prepared by the sampler at the rig for each hole as drilling progresses. Washed drill cuttings are cemented on the left side of a heavy paper log strip and individual sample assays, ore averages and waste averages are posted on the strip as returns are received.

All sample averages are weighted according to specific gravity and vein material assaying in excess of 1.1 percent copper are discounted to 1.1 percent. In addition to overall averages of ore and waste in each hole, averages are made for each 25 ft bench to be used in ore reserve calculations and mining operations.

Preliminary Pit

Sufficient new data were accumulated from crosscuts and churn drill holes to verify the information contained in old records to indicate an open pit operation. However, little was known of the metallurgy, type of blasting and mining most adaptable to the ground, ultimate slopes, etc. Also, actual mining experiences are best to determine the reliability of the churn drill data. A decision was made to excavate a preliminary pit within the orebody to obtain the needed information. The preliminary pit was located so that additional mining therein and enlargement would expand into the main pit if the results in the smaller pit were sufficiently satisfactory to warrant the large operation. An area between the Berkeley shaft and the Meaderville highway was selected for the test. A pit was planned to mine overburden ranging from 125 to 230 ft thick and to penetrate 100 ft into the orebody beneath the oxidized capping.

One of the principal reasons for the pit was to check churn drill data used to estimate the amount of waste to be removed, and the tonnage and grade of the ore to be mined. Thus when shipments were made, the accuracy of the drill data was known. The product was treated separately at Anaconda to determine the proper treatment necessary to obtain the maximum recoveries of metals.

The top four benches in the preliminary pit, according to churn drill data, contained 597,966 tons averaging 1.01 percent copper, and shipments from the same benches totaled 719,051 tons averaging 0.98 percent copper, a very close check on the grade. Blast hole samples averaged 0.93 per-

cent copper. Rotary drills equipped with a special device for dampening the cuttings to eliminate dust were used for blast hole drilling. The results were sufficiently encouraging that decision was made to proceed with the main pit.

The mining was done by a contracting company, but will be done ultimately by The Anaconda Company.

Ore Reserves

Insufficient data are available to estimate the tonnage and grade of the entire deposit beyond the planned pit. Presently, drilling near Silver Bow Creek, east of the Meaderville highway, is demonstrating that the orebody extends east under the deep wash. Until delimited, no estimate of the total tonnage is possible.

Proposed Main Pit

Surface features, such as highways, railroads and Silver Bow Creek restrict mining operations at present in the east extension of the orebody. West of these limitations, a pit has been designed by the geological and mining engineering departments.

Benches are 50 ft high in the leached capping waste, but are limited to 25 ft in the ore. More selective mining resulting in a higher grade ore product because of less waste contamination is possible with shallow benches.

The northwest end of the planned pit adjoins Kelley block cave stopes, and because of the broken ground and subsidence caused by the adjacent block caves, the ultimate slopes on the finished pit will be 38°. Where Kelley mining has not affected the ground, the ultimate slope planned is 45°. Because of icy, slippery roads in the winter, haulageways in the pit are limited to a 7° maximum grade.

The churn drill holes were plotted on each bench map, and the average grade for the 25 ft of hole on each bench was used to ascertain the grade of the ore. To determine the area to be represented by each hole, polygons were constructed in which sides were established at right angles to a line drawn from one hole to the next. The polygon side was plotted at right angles to the connecting line midway between holes and was extended to its intersection with other sides established in like manner between adjoining holes. Thus a weighted average grade was obtained for each bench as the grade of the hole is assigned to the tonnage within the polygon.

International Business machines were used to calculate the ore reserves and classifications were made showing the tonnage of the different grade materials on each bench.

No attempt was made to decide the ore-waste cutoff because of lack of mining experience and changing economic conditions. Two setups were made. In one the cutoff is 0.4 percent copper and in the other, material containing less than 0.5 percent copper was assumed to be waste. The stripping ratio of waste to ore is 1.6 to 1 for a cutoff at 0.4 percent copper and 2.1 to 1 for 0.5 percent.

Rail Haulage at Climax

(*Continued from page* 31)

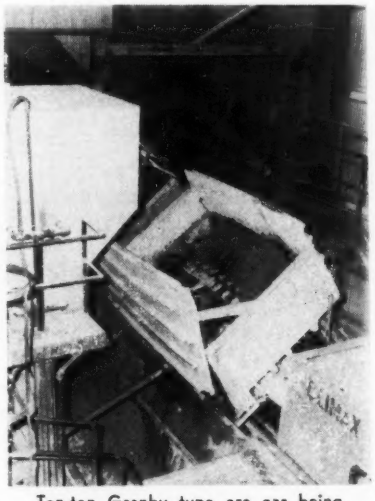
trains are thus dispatched by any one or a combination of the above. The two haulage levels are on separate frequencies for our radio telephones. This arrangement prevents interference between the two systems.

Two dispatchers are located on each level; one outside at the portal and one at Number One Switch. The dispatcher located underground is responsible for all train movement. Control of trains from the loading areas is handled by master control boards located at Number One Switch. Outside movement is controlled by a control board in the outside dispatch building. It is through the electrically interlocked control boards that each main track intersection is guarded with a dead section of trolley or a derailer. Trains dumping at the ore bins on the Phillipson Level are protected by an automatic derailer with a time delay for closing.

In the loading drifts a system of electric buzzers and bells is used to let the motormen know when to spot cars. Lights are used between the "whistle punk," who loads the cars, and the slusher operator above. It is not unusual to load from two or three slusher drifts at the same time into the same train. This type of loading gives the slusher operator time to bring ore from the back fingers, if necessary.

Trains Reach Speed of 15 mph

Average haulage distance on the Storke Level is approximately two miles. On the Phillipson Level the distance is nearly three miles. Track grades vary from 0.25 percent down grade in the Storke Level adit to 1.5 percent from the Phillipson Level portal to the bins. In the loading drifts, 0.40 percent grade is usual with the trains loading down grade. The main haulage curves are 175 ft radius curves, and the curves leading into the loading areas are 100 ft radius curves. A combination of a curve followed by a switch on our main line



Ten-ton Granby type ore car being cleaned with "ram-type" car cleaner

on the Storke Level has been cause for most of the serious wrecks on that level. Trains haul 20 to 24 cars, depending on track grade and size of locomotives. Average speeds, which include dumping, are 8.9 mph on the Storke Level and 5.4 mph on the Phillipson Level. There are times during the haulage cycle that our trains reach a speed of 15 mph. An isolated ventilation system maintains clear air at all times and seal beam headlights on the locomotives give excellent visibility.

Accident Experience

Safety and training go hand in hand at Climax, and are practiced by supervisors constantly. On-the-job training books and safety manuals, authored by our production bosses, are used for training aids.

Accident experience for the past two years for the production crews:

	Frequency	Severity
1954	127.76	5805
1955	67.06	2163
1956	46.60	704
1957, to date	41.62	166

The following are the formulas used at Climax to calculate accident experience:

$$\text{Frequency} = \frac{\text{No. of Disabling Injuries} \times 1{,}000{,}000}{\text{No. of Man-Hours Worked}}$$

$$\text{Severity} = \frac{\text{No. of Days Lost} \times 1{,}000{,}000}{\text{No. of Man-Hours Worked}}$$

It is on this type of haulage system that crews on the Phillipson Level have hauled 10,184 tons of ore in an eight-hour shift with nine trains on the run, and 11,593 tons of ore have been hauled on the Storke Level in a similar period with five trains on the run. Efficiency on the Storke Level production crew is about 300 tons per man shift on a two shift basis. This figure on the Phillipson Level is about 140 tons per man shift on a three-shift basis. Total plant, including all employes, is 20 tons per man shift.

Haulage costs were reduced in 1955 over 1954 by approximately four percent. This can be attributed to larger tonnages hauled during 1955.

Payroll costs increased slightly in 1956. It was the only noticeable cost increase when compared with 1954 and 1955.

The figures well illustrate what is being done on the Continental Divide of the Rocky Mountains by the men and staff of the Climax Molybdenum Co.

CONTINUOUS MINING AND SERVICE HAULAGE

By GORDON L. GEORGE*

A change from shuttle car haulage to conveyor and Piggyback haulage increased output by more than 17 percent

IN April 1956 the Simpson Coal and Chemical Corporation purchased the Wyatt Coal Company and immediately began to expand production. The No. 2 Gas mine, with which this article concerns itself, was opened by Wyatt Coal Co. on May 14, 1946. Originally coal was hand loaded onto chain conveyors. Later, two Jeffrey loading machines and Goodman shaker conveyors equipped with Duckbills were used for coal loading.

In 1955 the mining method was again changed. A 76 AM Jeffrey Colmol was purchased for one section. It was serviced by a Joy 14 BU loader and two Jeffrey shuttle cars. On the other section, conventional mining was practiced with a Joy 14 BU loading machine, two Jeffrey shuttle cars, a 35 BB cutting machine on a Jeffrey machine truck, and a hand held 572 Chicago Pneumatic drill comprising the major equipment.

Since Simpson Coal and Chemical entered the picture, one set of three Long M500G conveyors were purchased to serve the Colmol, replacing the shuttle cars. Additional equipment that has been installed to increase production includes: hydraulic hand held coal drills, one 14BU Joy loader, three Long M500G mobile head chain conveyors, one Colmol and two 11 RU cutting machines. A Belknap washer with a capacity of 150 tph of washed coal has been installed in the tipple. It was put into operation March 11, 1957.

Seam Characteristics

The mine is operated in the No. 2 Gas seam which averages from 42 to 48 in. in height through the area. The top is a firm slate and sandstone. In most cases posts and cap pieces are sufficient to hold the top. From 4 to 12 in. of draw slate is encountered in some sections and is taken down as the faces advance in headings. In rooms it is held, if possible. Rolls or faults are noted in some sections. These come down from the top into the coal as much as 12 in. and are a mixture of slate and sandstone. Breaking or cutting these rolls is difficult. The seam contains about 1.8 percent sulphur. General dip of the coal is three percent to the northwest with grades up to 8 and 10 percent being found. The bottom is a hard fire clay which softens when wet.

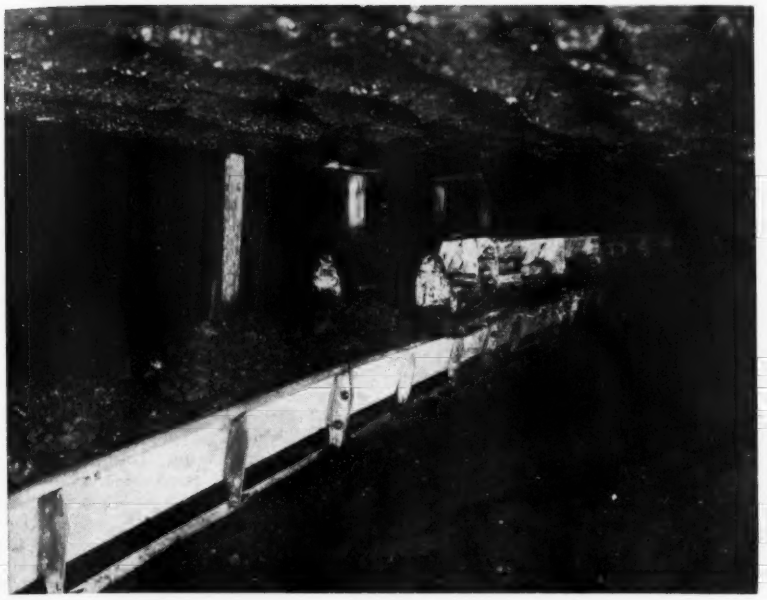
Mining Plan

Mining, at the present time, is along the lines of the following general plan:

Five entries are driven on 60-ft centers; cross cuts in mains are on 80-ft centers, and in room entries, on 54-ft centers. Entries are driven 27 ft wide; cross cuts 18 ft wide. Rooms are driven 36 ft wide by 300 ft deep on 54-ft centers.

In driving entries with the Colmol, three right hand entries are maintained as air intakes and the two left hand entries as returns. Places are numbered from left to right. When mining, the number five entry is advanced a total of 100 ft, with a cross cut being driven left toward number four entry 54 ft from the starting point. The Colmol, Joy and Piggyback are then moved to number four entry which is driven a total of 200 ft. The first cross cut is cut into at the 54-ft point and a second cross cut is turned to the right at the 108-ft point, cutting into the face of number five entry. A third cross cut is made at the 162 ft point. The Colmol, Joy and Piggyback are then moved

* Superintendent, Wyatt Coal Co.



A distance of 85 ft is needed from the conveyor discharge head to the face to set mining equipment and begin to extract coal

back into number five entry which is advanced another 200 ft for a total of 300 ft. Equipment is moved back to number four entry which is advanced 100 ft. This establishes the air. Equipment is then moved into three, two and one entries, respectively, where the total distance of 300 ft is driven in each entry without moving out of the place.

After a cycle is completed, a 270-ft belt extension is made and the procedure repeated. The cycle for mining rooms is similar. Two places are driven up 300 ft, alternating from place to place to establish the air circuit. After the first two rooms are driven, all remaining rooms on the panel are driven the full 300 ft without moving the equipment. Breakthroughs are turned to the completed room. A conveyor head is set and panned up ready to work in advance of the current working place so that in case a move comes on shift it can be made in one to one and a half hours.

Equipment Used

On each section there is a 76AM Jeffrey Colmol, one 14BU Joy loader, one PT 15 Long Piggyback and three Long M500G chain conveyors — two 300 ft long and one 70 ft long. At the outby end of the room conveyor system, coal is fed to a 26-ft transfer conveyor which feeds into mine cars. Eighty-five ft of space is needed between the conveyor discharge head and the face to set up the string of mining and conveying equipment and start to mine coal.

The Colmol begins its first run on the left side of the place, clearing the spad line six in. from the right rib. This run is nine ft wide and is made 36 ft deep. The machine is then pulled back, all bits are checked and the dull

Bit costs during 1956 on the Colmol averaged eight cents per ton

ones replaced. While the bits are being set, a row of wood posts is set to the face of the first run. After the second run is made, posts are set and bits checked as in the first run. The third run is made in the same manner as the first two runs, giving a total advance 27 ft wide and 36 ft deep. After the third run is completed, the Joy and the Piggyback are moved back from the face and six pans are installed in the room chain conveyor. This requires from 18 to 20 minutes. All men help make the pan installation. The face cycle is then repeated to advance another 36 ft.

Produce 50 Tons Per Man

In headings, average production is between 300 and 350 tons per shift, or 37 plus tons per man. An average of 400 plus tons, or 50 plus tons per man, is achieved in rooms. A maximum of 532 tons has been produced on one shift in room work. The Colmol's average penetration rate in rooms is approximately 24 in. per minute. A maximum of 32 in. has been obtained. Average penetration in entries is 18 in. per minute.

A face crew consists of one Colmol operator, one Joy operator, two face utility men, an electrician, one foreman and a boom man who handles two sections. The two utility men set timber, handle cables and water line, rock-dust and clean-up spillage. One uses a Joy T2 truck and handles all supplies.

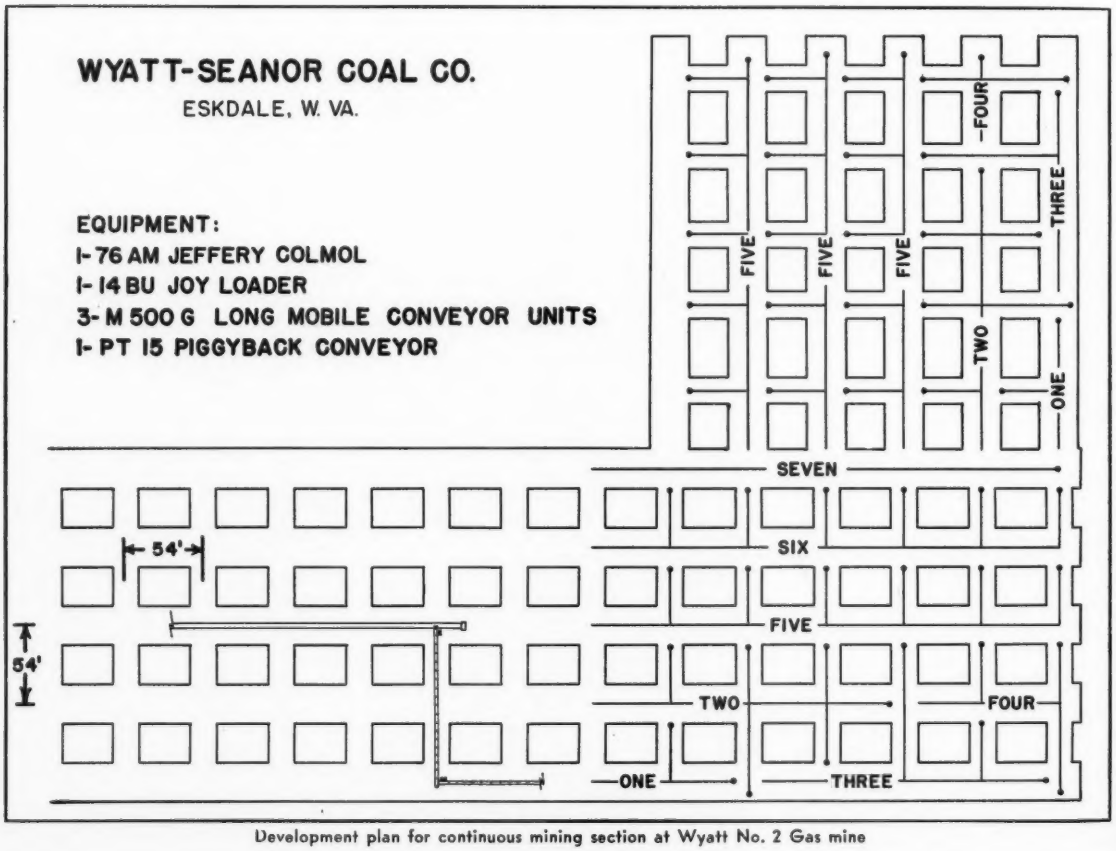
Straight posts with cap pieces are used in timbering. In a 27 ft place, four rows of timber are set. One row is set on each side of the pan line, a 10-ft roadway is left, and the other two rows are set on the right hand side of the place. Timbers are on six ft centers and safety posts are set as the face advances.

In a normal shift from 150 to 175 carbide tipped cutting bits are used. Bits are reground several times, however, and 1956 bit costs averaged eight cents per ton on the continuous mining machines. Water sprays are mounted on the machines to combat dust.

A crew of four utility men, two electricians and one foreman work on the third shift. They move all pan equipment to a new set-up and place the mining equipment in readiness for operation on the first shift. Major repairs and servicing of equipment is done by this crew. All moves are scheduled for the third shift. Occasionally, however, it is necessary to move the equipment between the day shift and second shift. This move is made with the day crew at overtime rates.

Haulage Change Has Helped

The change from shuttle car haulage to conveyor and Piggyback haulage from the Colmol was made in July 1956. In April, May and June the Colmol, using shuttle car haulage, was mining both entries and rooms and averaged 310 tons per shift. In August, September and November the Colmol also mined both entries and rooms, now however using Piggyback and conveyors for haulage, and the average was 365 tons per shift. July was eliminated from the comparison because that was the month of the change-over. The comparison on the three-month periods was made because the Colmol in both cases was in both rooms and entries approximately the same amount of time and was operating under similar physical conditions.



Development plan for continuous mining section at Wyatt No. 2 Gas mine

Shaft Sinking in Uranium Mining

An outline of the more important features of current practice in shaft sinking on the Colorado Plateau, this article covers such projects as two and three compartment shafts using conventional timber, calyx shafts lined with steel casing, an elliptical shaft lined with multiplate liner, large diameter churn drill holes and other shaft jobs

By PHILIP LINDSTROM

A 1941 graduate of the University of Washington in Mining Engineering, Philip Lindstrom, Superintendent, Utah Operations, Hecla Mining Co., has had experience in the gold mines of the Salmon River of Idaho and Grass Valley, Calif. He worked for Howe Sound Co. at the Holden Mine near Lake Chelan, Wash. For the past 14 years he has been with the Hecla Mining Co., mostly in the Coeur d'Alene Mining District. During the past year he has been in charge of the Hecla-U & I project at the Radon Mine near Moab, Utah.

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SHAFTS are becoming more important on the Colorado Plateau because the search for ore has been successful back from the rims and deep drilling is revealing new ore bodies.

This account can only briefly outline some of the more important features of current practice.

Plateau shafts are not deep, 700 ft being a maximum, but they represent the best thinking of each operator to fit his particular problem. Lack of capital will often dictate the selection of a shaft plan not suitable to the economic extraction of an ore body.

The combination of conditions that lead to a decision on mining an ore body are unlimited. Skill obtained by observation and experience is necessary to properly analyze the existing conditions before the first stone is turned on any project.

Many Plateau miners are handicapped by high costs due to lack of good timber close at hand, long water hauls, ore hauls often over 100 miles on poor roads, and the necessity of generating their own power. On the other hand, they usually have easily drilled rock, seldom have a pumping problem, the formation is flat-bedded, being ideal for vertical shafts and they usually enjoy "open weather."

Small Operations

Our sympathy goes to the shaft mine supported by two or three men with little capital. They commonly operate on a split-check leasing system on perhaps a 40-60 to 60-40 split. The owner offers the property and the lessee provides his equipment, supplies, power, and labor. Their ingenuity and cost-saving practices have been successfully extended to some shaft mines. They operate with gasoline-driven hoists, powered by second-hand automobile engines and often nothing more than an "A" frame with a swinging dump door and a bucket dumping directly into a truck.

Some small operations use the incline shaft method of development so that the crew can enter and leave the mine without the services of a hoist, thus allowing considerable economy in a one-compartment shaft. The headframe is eliminated by building up a ramp to the ore bin with waste rock from the sinking operation. The sinking slusher hoist and scraper bucket can be used in the mine after the shaft is completed, and mine cars can be hoisted in the incline, saving the cost of a skip or cage.

Four Corners Area

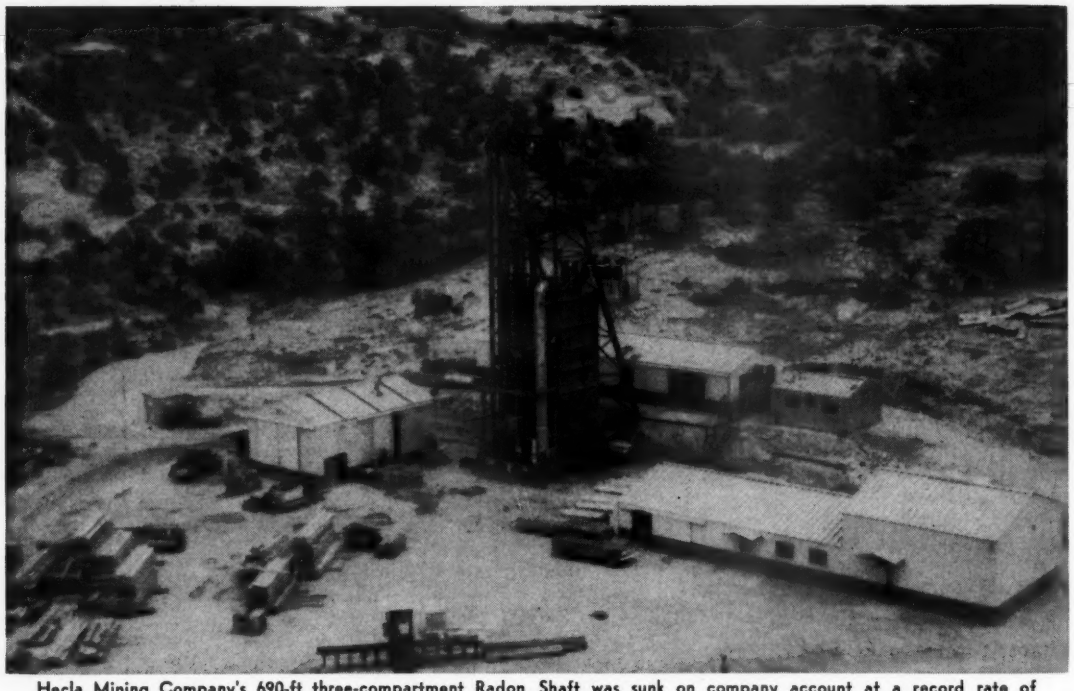
A good example of uranium leasing using vertical and incline shafts can be seen at the Four Corners Uranium Corp. property 12 miles due west of Green River, Utah.

There are about eight producing mines which will produce from 5 to 50 tons per day. After the company delineates the blocks of ore the lessee finds it to his advantage to sink several shafts because the development in waste between ore bodies is too costly. Depths of shafts are about 100 to 150 ft.

At one mine there is a two-compartment timbered shaft measuring 4 by 8 ft inside dimensions. The ore is slushed directly from adjacent stopes into 700 lb hoisting buckets.

Several operators were using such equipment as 125 cfm portable compressors, gasoline-powered blowers over bore holes, 25-ft and 30-ft wood headframes, and 55-gal drums for hoisting buckets.

Noticeable at one operation were



Hecla Mining Company's 690-ft three-compartment Radon Shaft was sunk on company account at a record rate of 10.2 ft per day, excluding stations

two 2 by 4's nailed together for shaft guides. Timbering is usually ten-ft vertical lagging and no guides.

Near Four Corners leasing operation at Green River is the Uranium Prospectors shaft owned by Vitro Uranium Co.

This is a 300-ft, two-compartment shaft using conventional 8 by 8 in. timber on six-ft centers. A 50-ft steel headframe supports a two-ton skip hoisted at 200 fpm. Unusual feature about this operation is the water flow of 75 gpm in an exceptionally arid area.

Temple Mountain

An especially unique shaft mining operation on the Plateau is the famous Temple Mountain District 34 miles southwest of Green River, Utah.

Consolidated Uranium Co. has 12 Calyx shafts 36 in. in diameter averaging about 125 ft deep. They are lined with steel casing for the most part. The sinking cost is about $35 to $40 per ft and is considerably cheaper than driving cross-cuts between scattered ore bodies that have been outlined by drilling. The sinking rate has averaged over ten ft per day. The Cline Brothers shaft is 145 ft deep, the longest tram is 1000 ft and six men work in the mine. The small shaft diameter presents some problems. The diesel-powered Scoot Crete buggies are cut up with an acetylene torch, the pieces are lowered in the shaft and the welding electrodes are droppd down the shaft to weld the equipment together again.

Small wood or steel headframes support a bucket holding 1500 lb of ore. Ore is loaded directly into a truck, using a conventional swinging dumping door in which a ball suspended by a chain from the bucket engages as the bucket is lowered for dumping.

This area is one of the most interesting small mining operations one might see, and is so unique and picturesque that it is well worth a mining man's visit.

Mineral Joe Shaft: A very clean, small shaft operation is the Mineral Joe Shaft of Climax Uranium Co., eight miles west of Naturita, Colo., on the west side of the Paradox Valley.

Climax sunk this two-compartment 255-ft shaft in April and May, 1954, using a Riddell shaft mucker. Three men on each of two shifts using a V-cut pulled almost five ft per round and bottomed in two days less than six weeks. Compartments are 5 by 5 ft and timber was 8 by 8 in. on six ft centers. Labor cost was $30 per ft. Mine cars are hoisted into the 45-ft steel headframe. A trestle passes from the headframe over two 50-ton bins and the cars may be dumped beyond the bins onto a waste dump. This method has attractive possibilities when both ore and waste are hauled on the same shift and the ore reserve is not large.

Bachelor Shaft: Four Corners Exploration Co. has a new shaft operation in the Bull Canyon District between Naturita and Slick Rock, Colo. Their 325-ft two-compartment Bachelor Shaft was started on February 24, 1956, and bottomed on May 5. A two-man crew worked on each of two shifts. A 2½-ft round was broken, using an end-cut. An average advance was six-ft per day. Rock dimensions are 5 by 9 ft and compartments are 4 ft by 4 ft 4 in. This shaft is timbered with 4 by 8 in. cribbing which was carried down 20 ft at a time. A bearing set was placed every 50 ft. Two men can place 30 ft of cribbing in a shift. There is a two-in. space between the cribbing which is laid on edge.

Ore was mucked by hand into a 1500-lb bucket. Labor cost was $35 per ft.

This is another operation using a slusher pocket which seems to be increasingly popular on the Plateau. They use a 30-in. scraper with a five-hp slusher hoist that loads into a two-ton skip.

A 54-ft steel headframe has a 30-ton ore bin adjoining. A Vulcan hoist powered by a gasoline engine has a rope speed of 275 fpm.

Cribbing for shaft timber is popular in Colorado. It is a low cost method because less ground is removed for the same compartment size as a conventional timbered shaft, less timber is used, and timbering is fast. Square sets are placed at the station and slusher pocket.

Club Mesa Mine: The La Salle Mining Co. operates the Club Mesa Mine

about three miles west of Uravan, Colo. In 1951 they were first on the Colorado Plateau to erect a steel headframe with conventional skip dumping facilities and the first to use shaft guides.

Their 270-ft two-compartment crib shaft was started in February and completed in July. Two shifts of two to three men worked six days per week. The man-way is 4 by 4½ ft and the hoisting compartment is 4½ by 4½ ft. Cribbing is 3 by 8 in. with two-in. spacing and the divider is 6 by 8 in. Labor cost was about $30 per ft.

Bowen Shaft: The Golden Cycle Corp.'s 640-ft Bowen Shaft on Atkinson Mesa, a few miles north of Uravan, was the deepest on the Plateau in 1953. It has several interesting features, such as a welded 50-ft pipe headframe with two sets of dumping irons, one for ore and one for waste.

The two compartments are each 4 ft 6 in. by 4 ft 6 in. and are timbered with 3 by 8 in. cribbing. The labor contract was $55 per ft.

Sinking was started on June 2, 1953, and stations were finished on December 22, 1953. There was a ten-man crew spread over three shifts, operating six days per week. A V-cut was broken with four-ft holes and was mucked by hand.

Rajah Shaft: Beaver Mesa Uranium Co. has the novel 320-ft Rajah 28 Shaft in the Gateway Mining District, Mesa County, Colo. Its 5 by 9 ft eliptical shape is lined with Armco multiplate liner. Gene Bishop Inc., of Boulder, Colo., encountered an unusual flow of water when the shaft was being timbered by the concrete ring method.

Six steel sections, 18 in. wide are bolted together to form the eliptical ring down to 260 ft. The bottom 60 ft calls for 14-in. concrete rings cast around the perimeter every ten ft. The space is lined with two-in. vertical planking.

Churn Drill Holes: Recently more attention has been turned to ventilation and secondary exit shafts for ore bodies 500 to 700 ft beneath the surface.

Four 36-in. diameter churn drill holes have recently been completed, a 545-ft shaft at Uravan for Shattuck Denn, 395-ft and 420-ft shafts at Grants, N. M., for Mid Continent Uranium Co. and a 518-ft shaft in the Big Indian District of Utah for Homestake Mining Co. A 700-ft, 36-in. churn drill hole is being drilled for E. L. Cord in the Big Indian District. The Cord project is estimated to be finished in 180 twelve-hour shifts by Franklin Cowan Drilling Co. This is very fast progress compared to a shaft sinking job where extensive surface plant preparation is necessary. A 20-in. pilot hole is first drilled with a Bucyrus-Erie 28-L drill and is reamed to 36 in. and cased with 34-in. outside diameter 3/16-in. casing in 20-ft lengths. The 36-in. pilot reamer weighs 5000 lb.

The method is economical through sandstone, shale and mudstone. Deviation from vertical is 1½ ft at 300 ft in the Cord shaft.

Casing is welded with an outside band aligned, before welding, with two transits. Cost is $35 per ft to 500 ft and $39 per ft 500 to 700 ft plus $14 for 3/16-in. casing.

A practical operating idea used by the Texas well drillers on the Cord job is the setting of wire rope guy lines in drill holes and pouring molten sulphur around the wire in the hole.

Big Indian District

The largest concentration of deeper shafts on the Plateau is in the Big Indian District, about 35 miles southeast of Moab, Utah. Following Charles Steen's discovery of the world famous Mi Vida, drilling traced the ore northward for over six miles.

La Sal Shaft: The first deep shaft in the Big Indian was the La Sal Shaft sunk by Centennial Development Co. for Homestake Mining Co.

The description of the La Sal Shaft will be similar to that of the other Big Indian District shafts. Only the differences or unusual features of the other shafts will be mentioned in this paper.

The 572-ft three-compartment La Sal shaft was started during the last week of July and reached bottom during the last week of October 1954. There are three 5 by 6 ft compartments timbered with 8 by 8 in. rough coast fir. Outside corner posts are 8 by 8 in. and inside posts and dividers are 6 by 8 in. Outside lacing is two-in. and guides are 4 by 6 in.

Three men plus a hoistman on each of three shifts, working six days per week, averaged eight ft per day. The labor contract was $60 per ft. They passed through 60 ft of Wingate sandstone, 482 ft of Chinle, and 30 ft of Cutler formation. Only a very small amount of water was encountered at the Wingate-Chinle contact. Benching rounds were drilled with jack hammers and six-ft and seven-ft ten-in. ⅞ in. Copco steel.

A Riddell mucker with a ¾-cu yd clamshell mucked into 35 cu ft buckets. Air operated dump doors in the 42-ft wood headframe dumped the buckets directly into trucks. Ventilating air was carried through 20-in. galvanized fan pipe.

A slusher pocket at the 520 haulage level was driven each way 50 ft parallel to the wall plates, just under the station floor. A measuring pocket with down-cut chute gates holds one skip load when the ore is scraped level with the grizzly rails.

There are eight shafts and two bore holes in the Big Indian District that are down or are presently advancing.

North Alice Incline: Perhaps the most unusual one is the 3000 ft North Alice Incline of Homestake Mining Co. The depth is now 2000 ft and Centennial Development Co. is advancing at the rate of 20 ft per day with three shifts, six days per week and with a hoistman and two miners on each shift. There is a top man and two men on the full gang on the day shift.

The slope of the trestle is 5°, and the shaft is 13° to the bottom of the Chinle formation and follows the contact of the Chinle at a slope of about 8°. Rock dimensions are 8 by 8 ft.

This long, flat, incline shaft was chosen to provide economic access to the several scattered ore bodies prospected a large area and allowed a good choice for a plant site.

Very little timber is used. Sanford-Day bottom dump cars dump waste into bins under the steel trestle. A slusher ramp is used for shaft mucking.

Far West Shaft: Hidden Splendor's 570-ft two-compartment shaft was sunk by Centennial Development Co. for Almar Minerals Inc. Unusual features of this shaft are 36-in. galvanized ventilation pipe, a relatively fast 750 fpm hoist with counter weight on the second drum hoisting 2⅔ dry tons of ore. They also have a bottom-dumping Vulcan skip with an ore bin and waste bin inside the headframe. The 5 by 5 ft man-way has steel vertical ladders with expanded metal landings. Shaft timber is 6 by 8 in.

E. L. Cord Shaft: The E. L. Cord 660-ft shaft was sunk by Boyles Bros. at a rate of 8.9 ft per shift. The shaft is very similar to the La Sal Shaft.

Radon Shaft: Hecla Mining Company's 690-ft three-compartment Radon Shaft is unusual in that it was sunk on company account at a record rate of 10.2 ft per day, excluding stations. After the initial 21 ft was sunk and the 75 ft bolted steel headframe was erected, 669 ft was sunk in 65⅓ days under the direction of W. H. Love. Twenty-five to thirty, six and seven-ft holes were drilled per benching round. A Riddell mucker filled 30-cu ft cans that were hoisted at a maximum rate of 400 ft per minute. July 1955 was the only full calendar month when 310 ft of finished shaft was completed. This is thought to be only 17½ ft short of an all-time United States sinking record for any month.

As larger and deeper uranium ore bodies are developed on the Plateau we will see more efficient shaft and hoisting plants.

Bore holes will become more popular and the ingenuity of man will reveal greater efficiency.

The Place of Medium and Small Shovels IN STRIP MINES

By R. E. DOUGHERTY, JR.

Vice-President, Tasa Coal Co.

THE need for small and medium size stripping equipment is not passé in spite of the ever constant drive for additional yard moving capacity. Since most of our thinking is directed toward cost per unit of production, it is well to consider the needs of a particular job in relation to overall efficiency and cost rather than to generalize on increased dirt moving capacity.

Although the importance of large capacity stripping units should not be diminished, a real need still remains for the medium and smaller size shovels and draglines in certain operations.

Size of earthmoving equipment for strip mining is generally determined by several considerations. Usually these considerations include the following:

(1) Acreage of Strippable Coal
(2) Operational Mobility
(3) Local Topography
(4) Operational Balance

In order to better explain how these factors influence equipment choice, let's consider each one individually and in more detail.

Acreage of Strippable Coal

Stripping equipment of any type costs money—to purchase, to erect and to move. Therefore, the amount of strippable coal acreage available for mining assumes importance when related to the investment required. Mounting labor costs necessitate careful consideration on the part of the coal operator in the moving and erection costs of equipment. These factors alone set some economic limit to the expenses which can be incurred in planning an operation. Although it is desirable, when possible, to amortize equipment during the life of an operation, it is not always possible. In instances where it is not feasible, medium and smaller size equipment have an added advantage of low cost in moving to another location. Even though increased dirt moving capacity extends the limits of economically mineable coal, an economic limit still exists where large size equipment exceeds a profitable cost per ton.

The possible exception to this factor is the mining of a high quality coal. If the quality is high enough to substantially increase realization, the mineable acreage necessarily can be less.

Operational Mobility

Closely allied to acreage size is the need for mobility. When mineable coal acreage is insufficient to justify the purchase of a large size dragline or shovel, ability to move a unit to a new location with the least cost becomes an important factor. With small and medium size companies not only is cost important but, in addition, mobility is important in acquiring new coal reserves. This is evident in areas where large strip acreages are no longer available. Therefore, the ability to move equipment to smaller,

In addition to loading coal, this 2½-yd shovel also is used to remove binder between seams

more dispersed tracts of coal becomes an ever increasing advantage. This advantage not only is relevant to the producer, but also to the industry, since it has the effect of utilizing strip coal reserves to the maximum.

Local Topography

Mistakes have been made in choosing improper size equipment for stripping a specific type topographical terrain. Irrespective of available acreage and mobility, the consideration of proper application of equipment consistent with the nature of overburden to be removed is important. Frequently in hillside contour stripping the overburden increases so rapidly in relation to the horizontal width of cut that even large shovels quickly reach or exceed the economic limit of mining. Under these circumstances it is not uncommon to encounter severe rock conditions which further increase production costs because of the necessity for additional drilling and blasting. When such conditions are present, the use of medium size equipment is often the logical and economical choice.

Operational Balance

Well known are the cost advantages of a well balanced production cycle. Once the production of a mine is decided upon and established, any change in one of the production elements of the cycle must of necessity change the other elements. Unless the change is made, either by additional equipment or by increased working time, inefficiency will result.

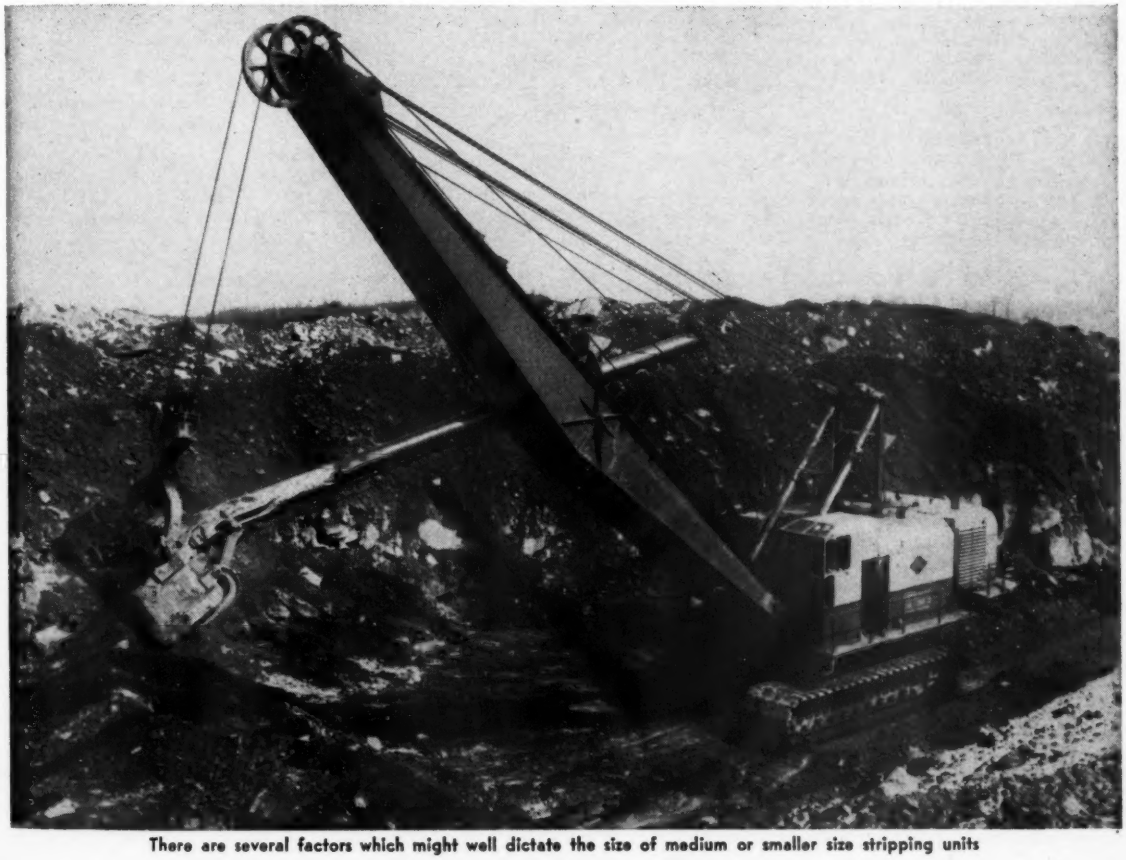
However, it is often practicable and economical to vary production with the addition of a medium or small size shovel or dragline. Without a large capital expenditure a smaller unit can be profitably used to remove low overburden followed by a large shovel or dragline to take the higher and heavier cover. Furthermore, this type of operation has an inherent flexibility which gives any strip mining operator an advantage. It is also true that maximum digging efficiency is not always attainable with large machines when working in extremely low overburden. Therefore, the differential in dirt moving costs between the large and the medium size machine is further decreased.

How One Company Uses Smaller Equipment

A general description of conditions and operating methods at a strip mine operated by Tasa Coal Co. in West Virginia will more clearly illustrate many of the factors favoring the use of medium and small size equipment.

The Peerless mine near Summersville, W. Va., has a capacity of 1800 tons per day. Medium size stripping units are used to strip four veins of coal with a total thickness averaging 16 ft. We are fortunate in that the veins are close together except for partings varying from six in. to eight ft. For simple identification the four seams are called A, B, C and D. Overburden is predominately a medium-hard sandstone, interlaced with shale. The main bed of sandstone is 30 ft thick and lies on top of 18 to 25 ft of shale covering the top seam. Although the stripping ratio has been about 3 to 1, the height of the highwall averages nearly 55 ft with 10 percent of the area having as much as 170 ft of cover.

The basic stripping and loading units at this operation consist of a



There are several factors which might well dictate the size of medium or smaller size stripping units

The first row of drill holes at Peerless is drilled to a depth that will give a 50-ft bench when the blasted material is pushed over the hillside

Lima 2400 shovel with a 5½-yd bucket, and a P&H 1055 shovel with a 2½-yd bucket. These units are supported by two HD-21 bulldozers and a truck-mounted Davey vertical rotary drill.

Stripping Procedure

General stripping procedure is to make a roadway at the back of the proposed cut with one of the bulldozers. In doing this an access road is prepared for the vertical drill. The drilling and blasting then consists of two separate steps. First, a single row of holes is drilled on 15-ft centers to a depth which will give a 50 ft wide bench when the blasted material is pushed over the hillside. The slope of the terrain is the governing factor for the depth of the blast holes.

After the broken material is pushed over the hillside and the 50-ft bench leveled, the drill crew sinks three rows of blast holes along the bench. Holes are spaced 12 ft apart in rows on 15-ft centers. The first row of holes is located approximately 5 ft from the edge of the highwall and serves as a base for the spacing of additional holes.

The Lima 2400 shovel is then used to remove the blasted overburden over the top seam. An attempt is made to blast and remove the overburden in such a manner that we are continually working on an outside curve. In so doing, we are able to dispose of the dirt without moving it a second time with the bulldozers. The Lima 2400 moves an average of 100,000 to 110,000 cu yd per month on an 18 shift per week basis. In addition to handling the overburden covering all the seams, this shovel removes a large portion of the partings separating the seams. Some of the rock between the coal seams can be removed without drilling and blasting. However, the thicker and harder material must be broken with explosives.

Coal Loading

The P&H 1055 also plays a dual role. In addition to its use as a loading shovel, it is also utilized to remove binder between the seams. The P&H 1055 is especially suited for its dual function because it has a 45-ft boom which allows it to cast the binder out of the pit when necessary.

In order to have coal continuously available for loading, a great deal of coordination is necessary in working the two shovels. The loading is actually a three-step process. However, before loading starts, the top of the coal is thoroughly cleaned. Course material is removed either by a bulldozer, motor grader or tractor shovel.

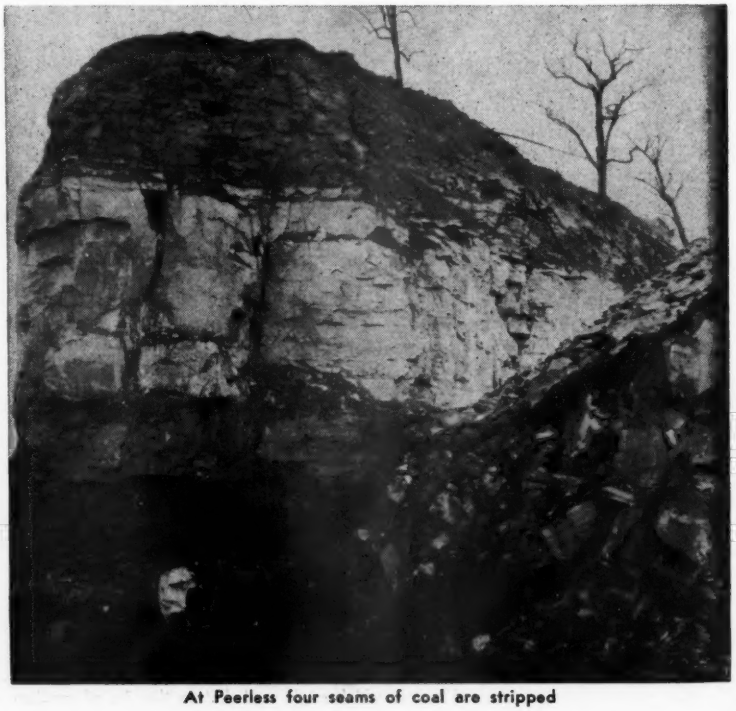
The P&H unit first removes about 300 ft of the top A seam, exposing the carbonaceous shale over the B seam. This material is friable and can be dug without blasting. The job of removing it is generally assigned to the Lima 2400. By working the second and third shifts, when coal is not loaded, the 5½-yd strip shovel removes the shale in one or two shifts per week, exposing the B seam. While the loading shovel is loading the B seam on the day shift, the Lima normally uncovers more A coal or removes rock between the B and C coals.

The interval of rock between the B and C seams averages seven ft in thickness and is extremely hard. It is necessary to use explosives to break this layer.

The C and D seams usually average a total of nine ft and sometimes are separated by a six-in. parting. When this occurs the parting is loosened by the P&H shovel after the C coal is removed and then is pushed to the spoil area by the bulldozer. Finally, the D coal is removed and the cycle is started again.

The operation of this strip mine embodies the principles of economic and productive use of the medium and small sizes of earth-moving equipment. There are many others, of course. Profitable use of medium and small earthmoving equipment is the backbone of the smaller operator. However, even the larger operators cannot overlook the many and varied advantages of this type equipment.

No specific equipment recommendation is meant by this article. Each interested manufacturer has equipment with special characteristics which satisfy the needs of a particular job or production organization.



At Peerless four seams of coal are stripped

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FOR MOVING EARTH, ROCK, COAL AND ORE

Solvent Extraction In The Metallurgical Industry

By ROBERT S. OLSEN* and
MERRILL F. McCARTY**

Proven to be a practical process for the recovery of uranium, solvent extraction has a great potential for processing other metals

SOLVENT extraction, as applied to metallurgical processes, can be described as an operation in which a selective organic chemical solvent, immiscible with aqueous solution, is contacted with hydrometallurgical solutions or pulps to extract metal values or impurities from the solution into the solvent. The extracted material is subsequently removed from the solvent in a more concentrated, purified or usable form. This definition differentiates between solvent extraction of solutions and pulps and solvent leaching of solids.

The first major metallurgical application of solvent extraction is probably the production of pure uranium salts from uranium concentrates undertaken by The Mallinckrodt Chemical Co. for the USAEC during the second World War and later by the National Lead Co. Numerous metallurgical applications of solvent extraction have been proposed but few have been used on a commercial scale.

Uranium recovery by solvent extraction has been studied intensively. The first commercial processes for the recovery of uranium by solvent extraction were developed by the Western Division Research Laboratory of The Dow Chemical Co. for the USAEC. Several other groups have also undertaken work on the recovery of uranium by solvent extraction. This work has made solvent extraction a commercial process in uranium milling. Much research and development work must be done before this unit process becomes a common metallurgical operation.

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The Solvents

There are two basic mechanisms which can be considered for metal solvent extraction. First, an extractable metal compound or complex can be formed in the solution to be extracted by the addition of a suitable chemical; or second, the solvent itself can contain the complexing or compound formation agent, the extractant, which removes the metal from the solution forming the complex or compound in the solvent. Both mechanisms might act in some cases. The complex forming agent could be either inorganic or organic in nature. However, inorganic compounds which are soluble in organic solvents are not common.

To prevent losses of the metal and extractant to the solution it is essential that the metal complex and extractant have low water solubility and high organic solubility. This requirement is incompatible with the first mechanism, that of adding the complexing agent to the aqueous phase, which would require that the metal complex and the complexing agent have reasonable water solubility.

It is logical that a suitable extractant will be chosen from the innumerable organic compounds; compounds which can be tailored to an amazing degree to meet specific requirements. The solvent might be composed of the complexing agent or extractant alone. However, since such a compound is likely to be relatively expensive it is desirable to minimize losses by using as small a quantity and as low a concentration as practicable. The extractant could be carried in a compatible organic solvent, such as the petroleum products or other inexpensive liquid organics.

Thus, for practical metallurgical solvent extraction, an organic compound which is soluble in organic solvent carriers, insoluble in aqueous solutions, and has strong compound formation tendencies with the metal under consideration is required. Further, the metal complex must be preferentially soluble in the carrier and the compound must be relatively specific for the metal extracted compared to other solution components. These extractant requirements are not unreasonable but selectivity is probably difficult to achieve when dealing with typical hydrometallurgical solutions.

The metal is removed from the solvent for final recovery by a stripping operation. Stripping is generally accomplished by contacting the "loaded" solvent with an aqueous solution which removes the metal. To minimize solvent costs, the solvent is usually recycled to the extraction unit after stripping; recycle requires a reasonably stable solvent.

The strength of the solvent works against stripping. This can be overcome by overwhelming concentration effects, utilizing an extractant which has a pH dependent extraction coefficient and stripping in a pH range different from that of the extraction, or using strip solutions of high complexing power. Other stripping methods such as precipitation, electrolytic recovery and distillation might also be considered.

Extraction

The theoretical side of solvent extraction is well developed. Solvent extraction depends on the favorable distribution of the extracted metal between the solution and the solvent. This distribution can be represented by a distribution curve which relates the concentration of the metal in the solution to that in the solvent after contact. Distribution coefficient is a "constant" frequently used to describe an extraction system and is the ratio of the concentration of the metal in the two phases at equilibrium. It is common to express the coefficient so that it indicates the desired direction of transfer. In usual systems the distribution curve is nonlinear and the distribution coefficient is not a con-

stant, but a function of concentration. The distribution curve flattens when the concentration of metal in the solvent approaches a saturation limit.

Solvent extraction can be likened to countercurrent decantation washing of solids. In CCD operation, the values are removed from a solid or pulp by contact with wash solutions; while in solvent extraction, the metal values are removed from a solution by contact with a solvent. The metal could be removed from the solution by solvent extraction in a single contact (stage), just as in CCD a single stage with very large wash volume could give almost complete washing. However, the use of multistage countercurrent contact in solvent extraction, as in CCD, gives higher recovery and less dilution of the extracted values.

The volume or weight ratio of solvent to solution (feed ratio) necessary in a solvent extraction operation depends on the recovery desired, the strength or affinity of the solvent and the number of stages used. These variables can be depicted graphically on the solvent-solution distribution curve, as shown in figure 1. The operating line is a line whose slope equals the feed ratio and is located by its terminal points which are the entrance and exit stream compositions. Feed ratio is commonly expressed so that a ratio less than one indicates transfer to a smaller volume. The product of feed ratio, B/A, and distribution coefficient, K, is termed extraction-factor, KB/A, and must be one or greater to achieve the theoretical 100 percent recovery in an infinite number of stages. The individual stage operations and stream composition are indicated as the "steps." This type of diagram shows the effect of the several variables.

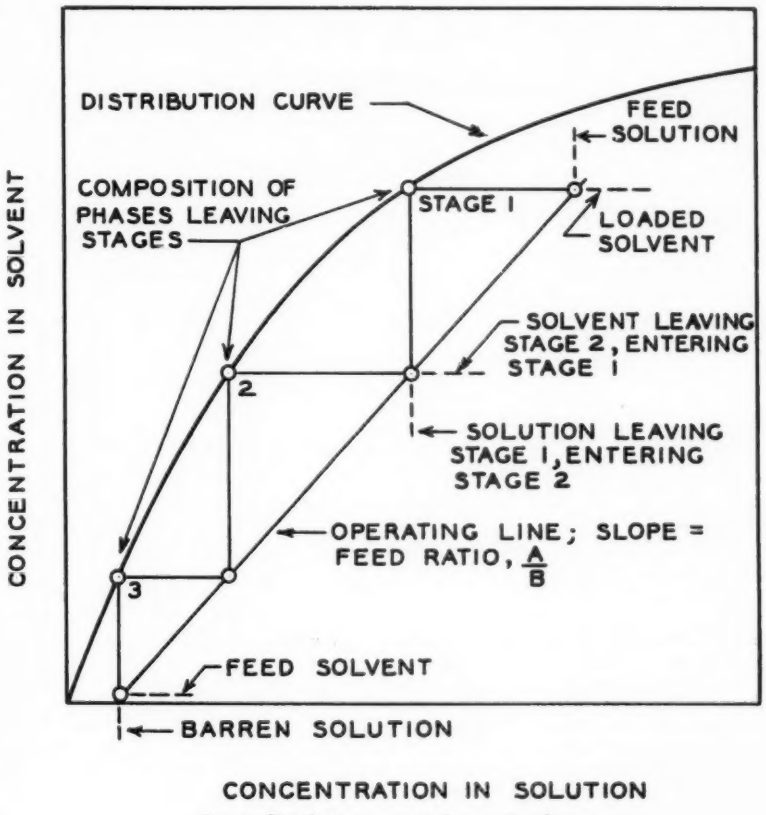


Fig. 1—Distribution curve and operating line

Stripping and Scrubbing

The stripping operation is exactly analogous to the extraction operation when the strip is by extraction from the solvent with a stripping solution.

In some extraction systems another operation termed "scrubbing" is introduced. Scrubbing is an operation on the solvent, either after extraction or strip, used to remove impurities which would otherwise be stripped and contaminate the final product or to remove impurities remaining in the solvent after strip which would interfere with the operation.

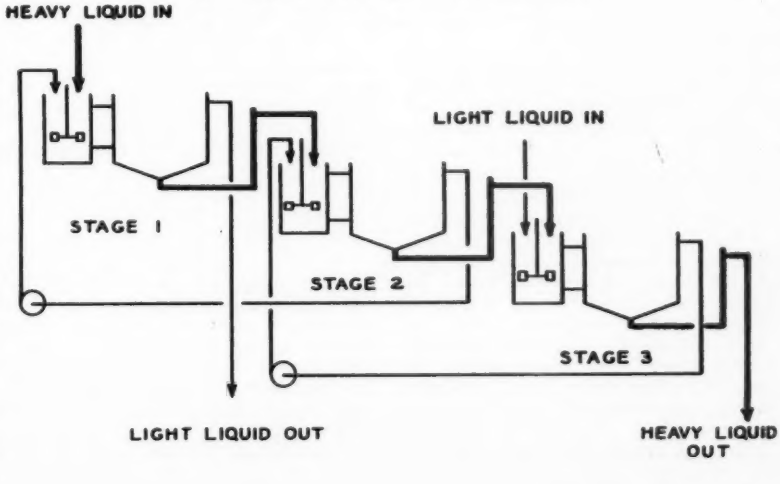
Solvent Extraction Equipment

A great variety of equipment for continuous countercurrent solvent extraction has been proposed. The variations can be divided into three categories: (1) mixer-settlers, (2) column contactors, and (3) centrifugal contactors.

In mixer-settler solvent extraction equipment each stage consists of a mixer and a settler of some type. The solvent and solution are fed to the mixer where one phase is dispersed in the other and extraction occurs. From the mixer the dispersion flows to the settler where the two phases are separated and leave the stage. For countercurrent operation several mixer-settler stages are arranged in series with the flow of the liquids countercurrent through the stages. A typical multistage mixer-settler is shown in figure 2. Many variations of mixer-settlers have been proposed and used.

Mixer-settler design is relatively simple and is divided into the two operations. The mixer is designed so that reasonably complete extraction occurs in the mixer. A residence time concept is a useful criterion. Mixing equipment design scale-up factors are

Fig. 2—Typical three-stage mixer-settler-extractor



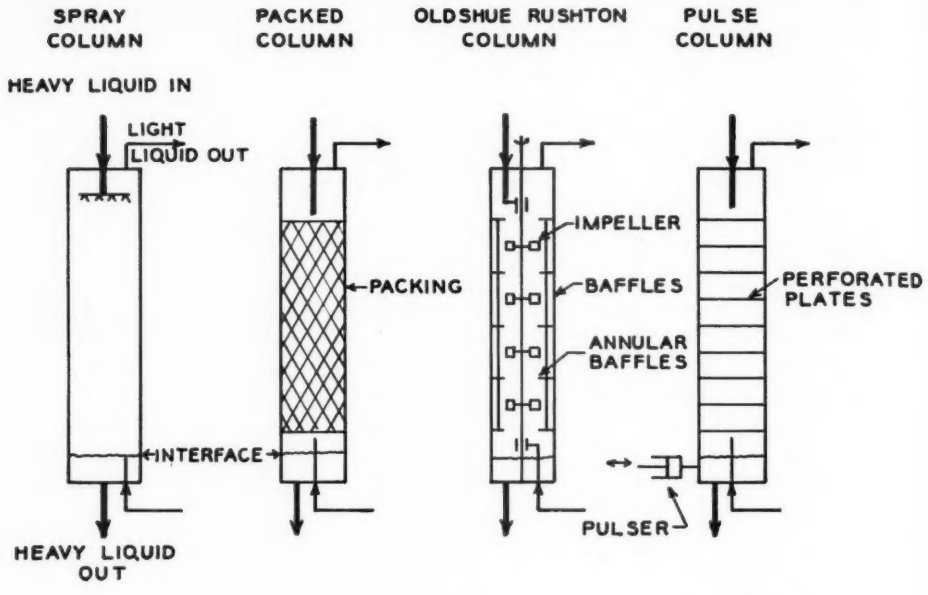


Fig. 3—Typical column contactors

reasonably well established. Settler design is analogous to thickener design and flow per unit area is a suitable design factor. Current metallurgical practice utilizes settling areas of from one to two gpm sq ft.

An important factor in settling characteristics is the choice of the continuous phase (that phase in which the other is dispersed). Emulsion breaking rate, the coalescence of the dispersed phase, is often quite dependent on the choice of the continuous phase. Further, after coalescence, the continuous phase contains some fine droplets of the discontinuous phase which settle slowly, while the discontinuous phase is clear. The phase which is present in the mixer in the largest amount, preferably 75 percent by volume or more, is usually the continuous phase. In cases where the feed ratio is less than the phase ratio desired in the mixer, recycle from the settler must be provided and can be made automatic by proper design. It is desirable that the solvent be the continuous phase in at least the last extraction stage to minimize entrainment losses of solvent.

Column contactors utilize gravity for countercurrent vertical flow through a column. The two liquids flow in a countercurrent manner due to their different densities. Some columns use mechanical means to maintain good dispersion. Numerous types of columns have been proposed and used. Typical are those shown in figure 3. The spray and packed columns are widely used in the chemical and petroleum industries, while the pulsed and agitator columns are relatively recent developments in solvent extraction.

Design criteria for column contactors vary with the different column types. A useful concept when dealing with column operation is "height equivalent to a theoretical plate," HETP. This term can be defined as the height of column which behaves, with respect to the extraction, as if it were a 100 percent efficient single stage.

Capacities of typical columns range from 2 to 15 gpm sq ft with HETP ranging from 2 to 10 ft. The cost per theoretical stage decreases with increasing number of stages when columns are used while for mixer-settlers it is about constant. It is estimated that column capital costs are more favorable than mixer-settler costs when the number of stages required exceeds four or five.

Centrifugal extractors are a recent addition to extraction equipment and utilize centrifugal force to increase the density difference between the two liquids to minimize phase separation problems. The best known are the Podbielniak Extractor, the Luwesta Extractor and the Sharples Super Centactor. These machines operate with from 2 to 10 theoretical stages. There is little public information on design and scale-up of this type of equipment.

Process Considerations

In practical solvent extraction operation, it is desirable that the solvent volume be as small as possible in order to minimize the size of operations following extraction. Likewise the size of operations on the strip solution are minimized by the use of small strip volumes. This requires that the feed ratios on extraction and strip be as small as possible. Feed ratios as small as $\frac{1}{10}$ to $\frac{1}{20}$ are feasible. However, for recoveries in the 95-98 percent range with four to five stages, an average extraction-factor of from 1.5 to 2 is required. This would require that the average distribution coefficients be from 20 to 40. Distribtuion coefficients of this order are not unreasonable, although they will not be attained without difficulty. In an extraction-stripping operation it would be reasonable to expect a concentration factor in the order of 100. Such a high concentration factor is probably limited to extraction from dilute solutions.

Work on uranium has shown that solvent extraction can be applied to slurries and pulps as well as clear liquors. At the present time solvent extraction of slurries containing up to about ten percent solids appears feasible and its use on higher density pulps shows promise.

One phase of solvent extraction which has been neglected here is the extraction of metal compounds from solutions of very high chloride or nitrate concentration with solvating type solvents. When these types of solutions are encountered or are feasible, their extraction behavior with these solvents should be investigated.

Economics of Metallurgical Application

A general economic evaluation of metallurgical solvent extraction will indicate the utility and limitations of this operation. Since process details are not known, many assumptions, which limit the accuracy of such an estimate, must be made. The following estimate considers process cost only, it does not include back-up capital or return on investment.

Individual items of plant and operating cost can be estimated for any

metallurgical solvent extraction operation using the relationships shown in Table I. These formulas were derived for a general case, neither the metal recovered nor the exact nature of the extraction process were specified. Only knowledge of the size of the aqueous stream to be treated, the feed ratios of the extraction and strip and the degree of complexity of operations on the strip liquor are necessary. The development of these relationships is described below.

Plant investment is based on a cost estimate of a solvent extraction uranium recovery plant which included extraction, strip and precipitation operations. A breakdown of section costs indicated that costs could be related to the size of the stream treated in each section; the aqueous feed in the extraction section, the product of aqueous feed and extraction feed ratio in the strip section and the product of aqueous feed, extraction feed ratio and strip feed ratio in the precipitation section. The precipitation section was related to the dissimilar extraction and strip sections by a degree of complexity factor. In the case of the uranium plant this section consisted of distillation, precipitation, filtration, drying and packaging with a degree of complexity of 7. For a simple operation such as precipitation and filtration it would be 1 to 2. Scale-up to other plant sizes was accomplished by the use of the 0.6 cost scale-up factor.

Solvent costs are due to solubility and entrainment losses. The loss of extractant due to solubility was assumed to be proportional to the concentration of extraction in the solvent and 0.5 g/l at 100 percent. The cost of the extractant was taken as $1.50 per pound and an equivalent weight of 250 was assumed. The concentration of extractant in the solvent was assumed to be 0.05 eq. per liter plus that necessary to hold all the metal at 1 eq. per eq. of metal. The entrainment loss is based on the assumption that 0.01 percent by volume of the solvent remains in the aqueous stream effluent. The diluent cost was taken as $0.25 per gallon.

Strip costs were derived on the assumption that stripping involved a reaction requiring one equivalent of a strip chemical per equivalent of metal at 50 percent efficiency at a strip chemical cost of $1.50 per pound equivalent.

Other chemical costs were assumed to be necessary for the general case. These costs were taken as ½ the strip costs.

Labor was estimated by taking the labor requirements of the uranium plant mentioned above and applying a 0.2 cost scale-up factor. A cost of $2 per man hour plus ten percent supervision plus 15 percent overhead was used.

Utilities were taken from the uranium plant estimate and it was assumed that no high utility consumption operations, such as distillation are used. Utility costs were assumed proportional to plant size.

Operating supplies were calculated as 4.5 percent of operating labor cost.

Maintenance materials and labor were assumed to be seven percent of plant investment per year.

Ind rect costs were taken as the sum of operating and maintenance labor.

Taxes and insurance were estimated as 1.5 percent of plant investment per year.

Depreciation was assumed to be ten percent of plant investment per year.

Using these relationships a crude economic evaluation of some possible solvent extraction operations can be made. A few examples follow to illustrate the economic limitations of solvent extraction and to demonstrate the method.

Recovery of Copper, Case I

Will solvent extraction be economically practical for the recovery of copper from a 1000-gpm stream containing one g/1 copper? Assume the solution density is 1.0, 1 to 10 feed ratios in both extraction and strip, and that the copper will be chemically precipitated to give a concentrate suitable for smelter feed in an operation with a complexity of X=1.5. The flowsheet for such an operation is shown in figure 4.

Estimated costs for this operation are given in Table II. A plant investment of $1,500,000 and an operating cost of $0.39 per pound copper are calculated. At these costs solvent extraction will certainly not compete with conventional iron precipitation.

Recovery of Copper, Case II

Examining the above costs it is obvious that chemical stripping costs and precipitation costs are a very large portion of the total. Another approach can be considered which would decrease these costs. Suppose the strip solution is suitable for feed to electrolytic recovery of copper with simultaneous regeneration of the strip solution. This would eliminate the precipitation section of the plant and by-pass the smelting operation.

Assume a plant treating 1000 gpm of one g/1 copper solution with extraction and strip feed ratios both 1/10. The precipitation cost is nil and strip chemical make-up is assumed five percent of that previously used. Utilities and labor are assumed to be reduced by ⅓. The estimated costs are shown in Table II. Here the plant investment is $1,400,000 and the operating costs are $0.22 per pound of copper.

These costs are too high to be attractive; however, they must be examined further. The largest item of operating cost is the solvent cost, $0.085. It is not inconceivable that this cost could be decreased by 50 percent or more. This type of process certainly warrants further investigation, with particular emphasis on the solvent.

TABLE I

COST SUMMARY

I. Plant Investment, $=$ $18{,}000\,(A_F)^{0.6}\left[1+(B/A)^{0.6}+X\,(B/A \times C/B)^{0.6}\right]$

II. Operating Costs

A. Raw Materials

1. Solvent Cost

a. Soluble loss, $/lb $= \dfrac{0.188}{C_A}\left[\dfrac{C_A}{eB/A}+0.05\right]$

b. Entrainment loss, $/lb $= \dfrac{d}{C_A}\left[0.0030+0.0368\left(\dfrac{C_A}{eB/A}+0.05\right)\right]$

2. Strip Cost, $/lb $= \dfrac{3}{e}$

3. Other Chemicals, $/lb $= \dfrac{1.5}{e}$

B. Labor, $/lb $= \dfrac{8.82d}{A_F 0.8\,C_A}$

C. Utilities, $/lb $= \dfrac{0.0130d}{C_A}$

D. Operating Supplies, $/lb = 0.045 labor cost

E. Maintenance, $/lb $= \dfrac{0.0000162\ Pd}{A_F C_A}$

F. Indirect Costs, $/lb = labor cost + $ \dfrac{0.0000069\ Pd}{A_F C_A}$

G. Taxes and Insurance, $/lb $= \dfrac{0.0000035\ Pd}{A_F C_A}$

H. Depreciation, $/lb $= \dfrac{0.0000231\ Pd}{A_F C_A}$

A_F=feed solution, gal/min
C/B=strip feed ratio
C_A=concentration of metal in feed, g/l
d=density of feed solution
B/A=extraction feed ratio
X=complexity of precipitation operations
e=equivalent weight of metal
P=plant investment

TABLE II
CASE COST ESTIMATES

Case	I	II	III	IV	V	VI
Metal	Copper	Copper	Copper	Zinc	Cu, Co, Ni	Cd
Concentration, g/l	1	1	10	10	10, 20	0.2
Size, GPM	1000	1000	100	100	25	25
I. Plant Investment	$1,540,000	$1,420,000	$425,000	$139,000	$497,000	$171,000
II. Operating Costs						
A. Raw Materials						
1. Solvent Cost						
(a) Soluble loss	0.0685	0.0685	0.0206	0.0200	0.0064	0.080
(b) Entrainment loss	0.0164	0.0164	0.0043	0.0041	0.0013	0.031
2. Strip Cost	0.0944	0.0047	0.0047	0.0046	0.0050	0.053
3. Other Chemicals	0.0472					0.027
B. Labor	0.0351	0.0234	0.0147	0.0074	0.0134	3.35
C. Utilities	0.0130	0.0087	0.0009	0.0004	0.0003	0.065
D. Operating Supplies	0.0016	0.0010	0.0007	0.0003	0.0006	0.150
E. Maintenance	0.0250	0.0232	0.0069	0.0022	0.0064	0.554
F. Indirect Costs	0.0457	0.0332	0.0177	0.0084	0.0161	3.58
G. Taxes and Insurance	0.0054	0.0050	0.0015	0.0005	0.0014	0.119
H. Depreciation	0.0356	0.0331	0.0098	0.0032	0.0092	0.790
Total (dollars per pound)	0.388	0.217	0.082	0.051	0.060	7.48

Recovery of Copper, Case III

The effect on costs of concentration of the metal in the solution is quite pronounced. A cost estimate of a plant treating 100-gpm solution containing ten g/l copper is shown in Table II. In this case the same assumptions made in Case II were used, except that extraction and strip feed ratios were taken as 1/3.33 and ⅛, respectively. A plant investment of $425,000 and an operating cost of $0.81 per pound copper is calculated. Here is a case where solvent extraction should not be overlooked.

Zinc Recovery, Case IV

Suppose that, in addition to ten g/l copper, ten g/l zinc were present in the feed solution of Case III; could the zinc be economically recovered by solvent extraction from the solution before or after copper recovery? Probably not. The magnitude of cost would be the same as for copper recovery. However, consider this possibility; suppose that the solvent could extract both copper and zinc and that it could be selectively stripped to give separate solutions suitable for electrolytic recovery of zinc and copper. Assume that the strip solutions are regenerated during the electrolysis and that five percent make-up is required. This flow-sheet is shown in figure 5.

The cost of this operation over and above the copper portion of Case III, is given in Table II. The strip feed ratio for zinc is assumed at ⅓ and the plant investment includes zinc stripping only. The solvent would have to have a higher concentration of extractant than would be required in the case for copper alone. This increased concentration leads to solvent losses attributable to zinc only. The plant is essentially a 30-gpm plant re-

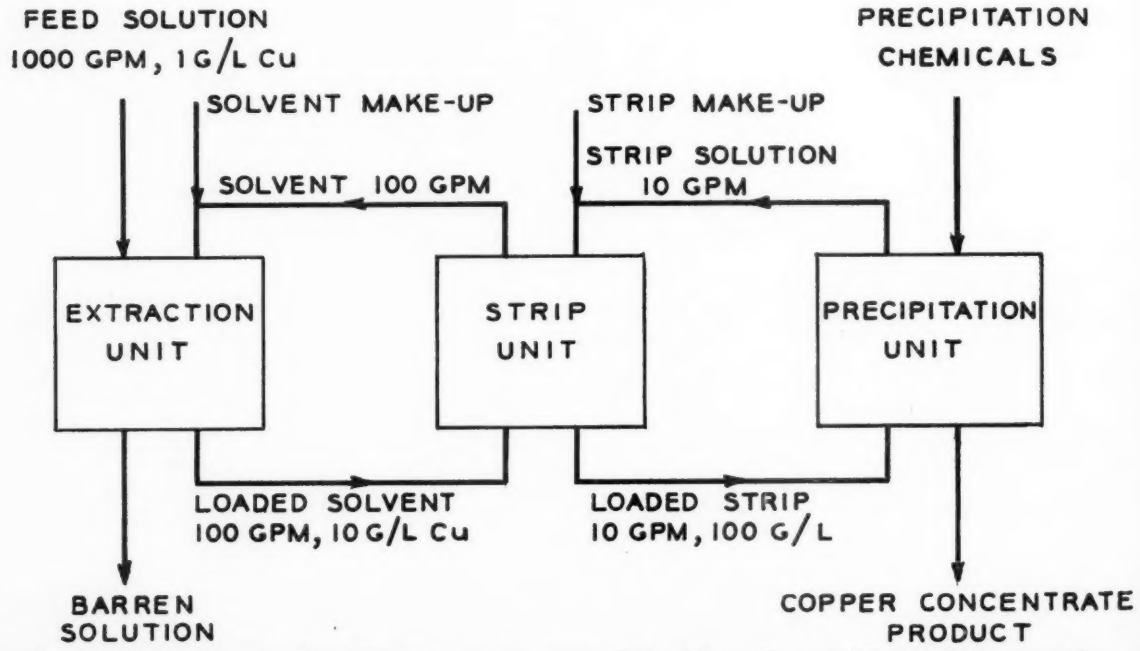


Fig. 4—Recovery of copper from 1000 gpm, one g/l copper feed solution with precipitation of final concentration

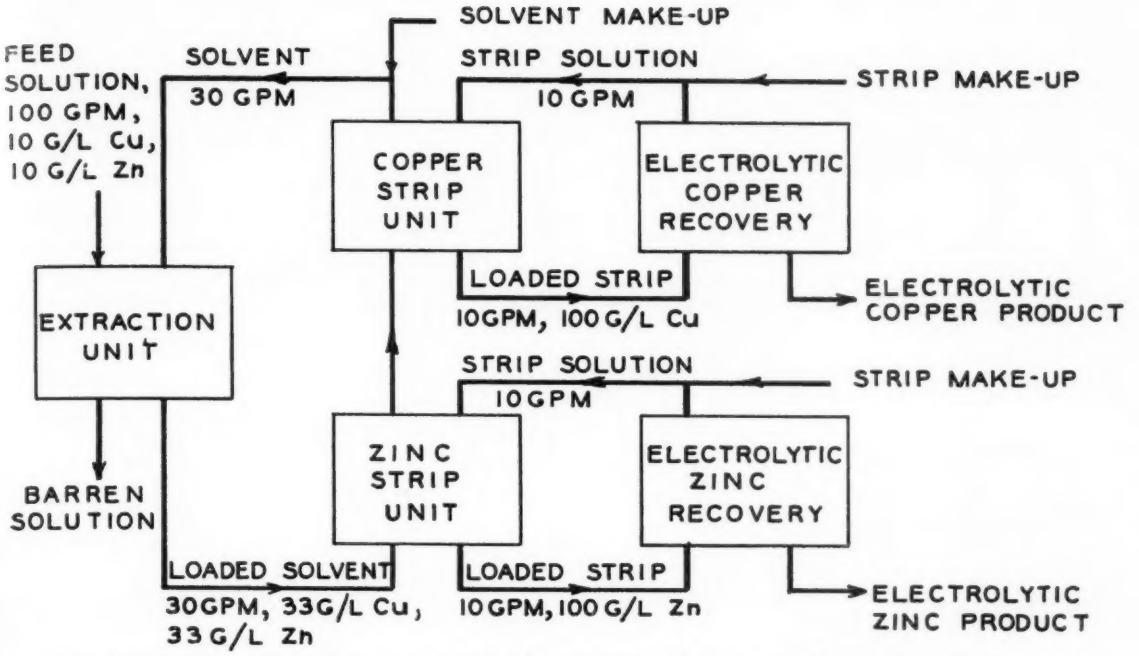


Fig. 5—Simultaneous copper and zinc extraction with selective copper and zinc strips followed by electrolytic recovery

moving zinc from the solvent into the strip. Labor and utilities are assumed to be ½ that of Case III.

This estimate indicates that zinc could be recovered in such a case for $0.51 per pound at a plant investment of $139,000. This estimate justifies further work.

Copper, Cobalt, Nickel Recovery and Separation, Case V

A particularly vexing problem in metallurgical operations is the separation of copper, cobalt and nickel. The estimate in Table II shows that solvent extraction is a promising approach to this operation.

In making this estimate a 25-gpm stream containing 20 g/1 copper, 20 g/1 nickel, and 10 g/1 cobalt was assumed. The proposed flowsheet, figure 6, depicts a single extraction operation in which the metals are extracted at 1/1 feed ratio and selec-

(*Continued on page* 80)

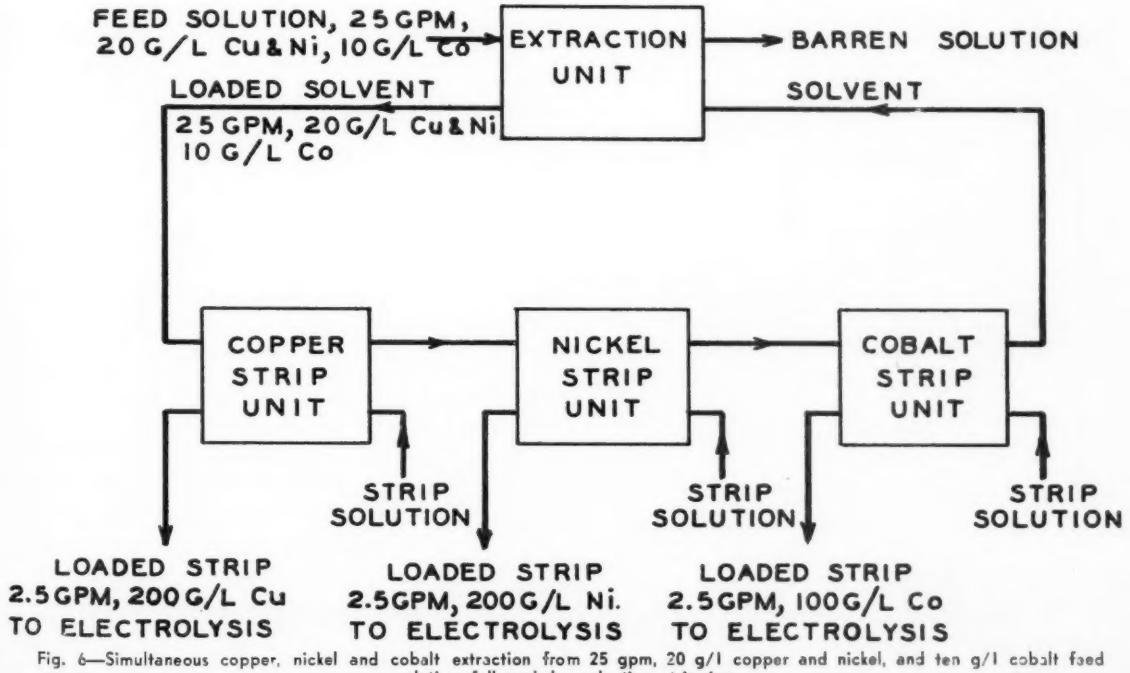

FEED SOLUTION, 25 GPM, 20 G/L Cu & Ni, 10 G/L Co
EXTRACTION UNIT
BARREN SOLUTION
LOADED SOLVENT 25 GPM, 20 G/L Cu & Ni 10 G/L Co
SOLVENT
COPPER STRIP UNIT
NICKEL STRIP UNIT
COBALT STRIP UNIT
STRIP SOLUTION
STRIP SOLUTION
STRIP SOLUTION
LOADED STRIP 2.5 GPM, 200 G/L Cu TO ELECTROLYSIS
LOADED STRIP 2.5GPM, 200 G/L Ni. TO ELECTROLYSIS
LOADED STRIP 2.5GPM, 100 G/L Co TO ELECTROLYSIS

Fig. 6—Simultaneous copper, nickel and cobalt extraction from 25 gpm, 20 g/l copper and nickel, and ten g/l cobalt feed solution followed by selective stripping

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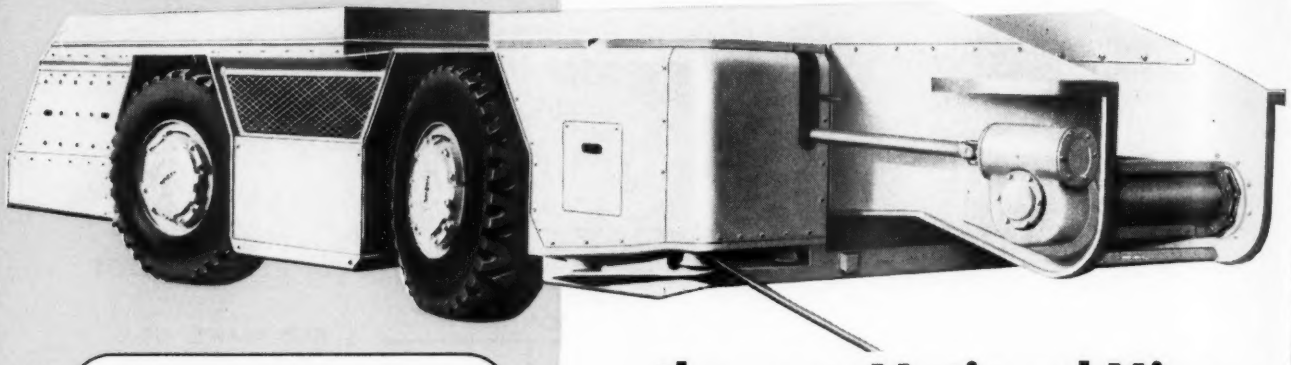
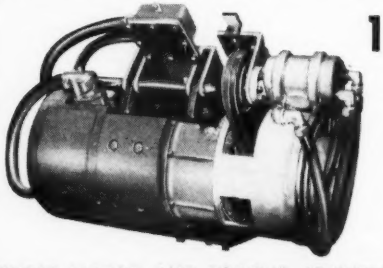
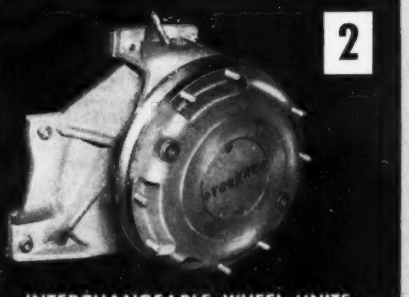




1

SINGLE MOTOR AND TORQUE CONVERTER



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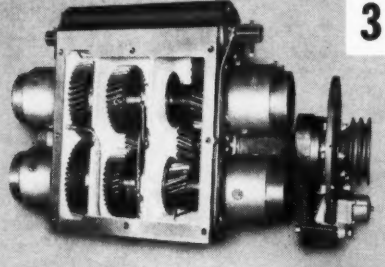
INTERCHANGEABLE WHEEL UNITS



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Organizing for Safety - - -

Accidents can be prevented! All it takes is a recognition of their great cost in human suffering and operating efficiency and then doing something about them

By LEONARD FLICKER

LEONARD FLICKER began his career in safety work in 1935 as safety inspector with the Bureau of Power and Light of the city of Los Angeles. There followed periods with the State of California, as safety inspector; Pacific Indemnity Co., as safety engineer, and the U. S. Department of Labor, as regional safety supervisor. In 1941 he joined H. J. Kaiser Companies in the capacity of safety engineer. In his present position as senior safety engineer with Kaiser he is responsible for safety direction at Permanente Cement Co., Kaiser Gypsum Co. and the California plants of Kaiser Aluminum & Chemical Corp.

BASIC concept in "Organizing for Safety" is, of course, the development of a plan of action to reduce to the minimum accidents in our plants and industries, thus eliminating needless waste of life and mangling of bodies.

Before establishing any worthwhile Safety Program it has long been established that top management must not only lend its support but it must actively participate in the Program. It is easy to secure top management's approval of a Safety Program—in this day it is rare indeed to find a management that is against safety . . . but it is another thing to find a management that is for safety. **In brief, to start a Safety Program, management must subscribe to the following basic concepts of plant operation:**

(1) Needless destruction of life and health is a moral evil.
(2) Failure to take necessary precautions against predictable accidents involves moral responsibility for those accidents.
(3) Accidents are destructive of efficiency and productivity.
(4) Accidents produce far-reaching social harm.
(5) The safety movement has already demonstrated that its techniques are effective in reducing accident rates and promoting efficiency.
(6) Nothing in the available data suggests that safety people are anywhere near a limit in their ability to extend the moral and practical values of accident prevention.
(7) Safety personnel have at their fingertips a tremendous body of knowledge, an effective, nationwide safety organization, an enhanced prestige, great economic resources, and a sound basis of confidence in their methods.

Convinced of these concepts, management must then be shown:

(1) Actual accident losses . . . all hidden costs included.
(2) How accidents affect plant efficiency.
(3) How accidents affect production and personnel relations.

The time is then ripe to present to management just what has occurred in their operations over past years. The data should cover a minimum of three years and go as far back of that as proper records can be secured. **These records should be studied and management presented with:**

(1) Record of outstanding severe accidents in past years.
(2) How these accidents happened and what could have been done to prevent them.
(3) The effect upon public opinion and/or plant personnel; opinion of these accidents.
(4) The costs of these accidents in medical care, compensation, permanent disability ratings, loss of manpower, damaged equipment and the other hidden costs of accidents.
(5) The relative record of the company compared with the accident performance of the industry.
(6) The effect of these accidents and the safety performance of the company upon the insurance rates for compensation insurance.
(7) Effect of the accidents upon union pressures for better working conditions.
(8) Effect of the accidents upon legislation aimed at preventing the types of accidents which have occurred. The coal mining industry has been greatly affected by the accidents which have occurred in that industry and has resulted in strict government legislation.

The further development of a safety organization moves logically to the conclusion that accidents are caused—eliminate the cause and you eliminate the accident. **The first thing to do here is discover the cause which will fall into one of the following categories:**

A. Physical hazards.
B. Personal hazards.
C. Other activities that tend to mold employe safety attitudes.

Causes Study previous accidents to develop causes of these accidents. Check on the physical condition of the plant and the manner in which accidents could occur due to sub-standard physical work conditions, guarding, etc.

Accident Investigation Establish proper formal accident investigation procedures. The foreman should be made responsible for investigation of accidents to his men. In serious cases a 'Board of Inquiry' should meet to study all possible causes of the accident and what can be done to prevent this reoccurrence.

Issue accident statistics regularly . . . give only such data necessary to show trends in safety performance. Keep the reports to a minimum length . . . if possible, to one page of data.

Physical Inspection Physical inspection of work areas should include the following:

(1) Check plans, blueprints, purchase orders, and contracts for safety
(2) Include guards in original design, orders, and contracts
(3) Provide guards for existing hazards
(4) Proper maintenance
(5) Sources of supply must be reliable
(6) Inspection for defects in plans and materials
(7) Correction of defects
(8) Formulation of safe procedures
(9) Provide suitable layout and equipment necessary for good housekeeping
(10) Improve illumination
(11) Improve ventilation
(12) Provide safe dress or apparel or personal protective equipment if management can reasonably be expected to provide it
(13) Specify the use of certain protective equipment on certain jobs

Control of physical hazards are advised because they can be clearly seen and their correction is oftimes one of the few visible evidences of sincere safety effort on the part of management that become known to the working force of the plant.

Personal Factors These can be controlled by:

Job Safety Analysis
Job Training
Supervision
Discipline
Personnel Methods
Physical Examinations
Placement of Workers

Other Activities These activities affect the safety attitude of the work force and include:

(1) Rule books.
(1) Rule books.
(2) Posters.
(3) Booklets; other literature.
(4) Movies.
(5) Film strips.
(6) Contests.
(7) Meetings.
(8) Committees.
(9) Suggestion systems.
(10) Employe magazines.

Use of these activities should be on a planned basis, not all at the same time and so handled as to develop and maintain interest in accident prevention on the part of the work force.

Three basic requirements for a Safety Program, then can be listed as:

(1) Active interest of top management
(2) Safe working conditions
(3) Safe work practices and procedures

Accidents can be prevented

Safety Organization The actual plant organization may differ considerably from plant to plant . . . but it must have certain essentials.

A. Policy making group—top management
B. Carrying out of the policy — foreman and supervisors
C. Those affected by the policy—the work force

Committees In practice safety committees vary in type, size and method of functioning. They are of various types depending upon the audience of each committee—workers. foremen, executives, etc. The union may be part of the program, either formally or informally. Special committees may be formed for studies of accident problems as they are needed.

The safety engineer's job is two-fold: (1) To formulate and direct the safety program, and (2) to influence everyone in the firm to do his part in preventing accidents

Responsibility for Accident Prevention In most plants the responsibility for accident prevention, while the legal and ethical responsibility of top management, must of necessity, be spread through the entire supervisory force. Management must provide the same leadership for safety as it does for production. All personnel must carry their share of responsibility for safety, from top management to the "man with the muck stick."

Top management should take part in the safety program in some of the following manners:

(1) Review of, and executive action upon safety records.
(2) Regular attendance at safety meetings.
(3) Action on good or bad departmental safety records through personal interviews with department heads.
(4) General letters, for bulletin

"I've often wondered why Smitty wore that safety hat around home!"

board posting, discussing the accident record in the plant and demonstrating management's interest.

(5) Setting a good example. For instance, if plant rules require employes to wear goggles or other personal protective equipment in certain areas, executive who expose themselves to such operations should conform to these regulations.

Committees offer a means for expression for all segments of the plant personnel.

Safe plant operation is more than a desire—it can be an actuality. An appraisal of the results which have been accomplished in the past cannot fail to show that operating a safe plant is good business and good sense.

Here are a few of the things which have been learned from the operation of satisfactory safety programs:

(1) Accidents can be prevented.

(2) To prevent accidents is good ethics and financially profitable.

(3) The expenditures required are relatively small.

(4) The technique of prevention is not difficult. It is primarily a matter of the unremitting application of common sense.

(5) Accidents are caused, they don't simply happen.

(6) It is important to discover the cause (or causes) of each accident, then to eliminate those causes so that similar accidents will not recur.

(7) It is even more important to discover and eliminate accident hazards BEFORE they become accident causes.

(8) Causes of accidents are more important than causes of injuries.

(9) Practically every industrial operation, no matter how simple, presents certain hazards than can be discovered and eliminated.

(10) In general, the great majority of accidents in all firms are due to similar causes regardless of size of the establishment or type of industry.

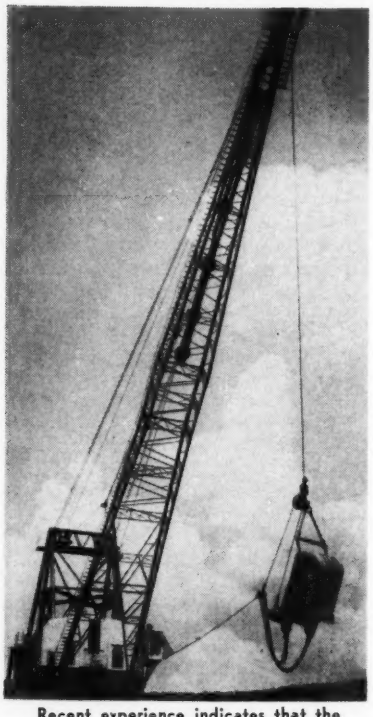
(11) Safety in any firm is not a one-man job. Accidents cannot be eliminated unless every man in the organization from the top executive down to the most lowly laborer accepts his share of the responsibility.

(12) Many of the methods used to control quantity, quality, and cost of production can be used with equal effectiveness to control accidents.

(13) The safety engineer's job is two-fold: First, to formulate and direct the safety program; second, to influence everyone in the firm to do his part in preventing accidents.

(14) It is not necessary to employ a full-time safety engineer, especially in the small firm, if some capable man will devote a part of his time to this two-fold job and if he will do it effectively.

Organizing for safety is the first step any plant must take in the war on accidents. This step must be made in the same way that any action is taken to combat other production problems. Good safety programs have been developed and operated by many companies. What it takes is a recognition of the cost in life, materials and equipment that result from accidents . . . AND THEN DOING SOMETHING ABOUT IT!



Recent experience indicates that the life of dragline drag ropes can be improved appreciably by the application of a light oil which does not pick up grit and dirt

EXTENDING Wire Rope Life

Scheduled inspection and proper maintenance can go a long way in lengthening wire rope life, thereby reducing rope costs

By B. N. CARLSON*

WIRE rope is only one of the working parts of an excavating machine and its performance is affected to a great extent by the condition and performance of other working parts with which it comes in contact, either directly or indirectly. Therefore, it is entirely logical that any program of wire rope inspection and maintenance should be matched with a program of inspection and maintenance of those machine parts which affect wire rope service. Because of this, the following article will encompass not only wire rope usage but also those factors which are the cause of reduced rope life.

Handling and Storing

Proper maintenance of wire rope should start even before the rope is placed in service because the beneficial results of excellent equipment maintenance can be nullified by careless handling and storing. This point is all too often not recognized, frequently because the handling and storing comes under a different responsibility than servicing after installation.

The most frequently encountered results of negligent handling and storing of wire rope are localized physical damage and corrosions. First let us briefly consider their effect on rope life.

Damage

In order to obtain efficient rope performance each wire in the rope must carry its share of the load. Unequal load distribution causes overstressing of some components with the consequence that these overstressed members are the first to fail. Obviously, if, through rough handling, some of the wires in a strand or some of the strands in a rope are displaced, the built-in balance of the rope structure will be disturbed. The resultant overstressing, which is generally accompanied by concentrated heavy abrasion of the wires at the damaged spot, can have no other end point than early failure.

Localized physical damage can also occur in the form of cut wires. The cut does not have to sever the wire in order to have a marked effect. As a matter of fact, all that is necessary to hasten fracture is to nick a wire.

Let me resort to an illustration with which we are all familiar. All of us, as boys, when we wanted to cut a piece of wire, hardly ever resorted to a pair of pliers. We just proceeded to bang away at the wire with whatever object happened to be handy. After marking and indenting the wire surface at the point where we wanted it cut, it was easy to complete the fracture by bending the wire back and forth at this spot. The same concentration of bending stress occurs when a nicked wire in a wire rope is flexed by running over sheaves and drums, and the same accelerated fracture results.

Corrosion

When a rope is bent over a sheave or drum, the individual wires must move with respect to each other if the previously mentioned distribution of load is to be maintained. Obviously, the friction between wires must be kept at a minimum in order to realize unrestricted movement. Wire surfaces which are roughened by corrosion cause ropes to become "rustbound." When such ropes are bent, the wires on the outside of the curvature are subjected to high stresses because they cannot slide freely and adjust for the change in direction of load application. This is why rusty ropes develop early wire breaks. Furthermore, pitting of wire surfaces from corrosion is just as detrimental as a series of nicks because these pits are focal points for fatigue fractures to start.

* Chief Wire Rope Engineer
American Steel & Wire Division
U. S. Steel Corp.

Wire ropes are lubricated during their manufacture for the dual purpose of reducing friction between component parts and providing corrosion resistance. However, additional protection from the elements may be necessary to prevent corrosion if storage conditions are unfavorable.

Not infrequently the factory applied lubricant is rubbed off a small area during transit or handling. If such areas are promptly smeared with grease, corrosion can be prevented and the future necessity of replacing a rope which is in excellent condition except for one spot of concentrated wire breakage can be avoided. Inspection and maintenance during handling and storing can be vitally important in extending rope life.

Wire Rope in Operation

In strip mining operations it is essential to make periodic inspections of all wire ropes if accidents are to be prevented. These inspections should be frequent enough so that any change in the condition of the rope will be found before it becomes dangerous. However, in order to improve rope life, the inspection results must be studied and translated into an effective maintenance program. In making a rope inspection, the following features should be observed:

Lubrication
Amount of Wear
Distribution of Wear
Localized Wear
Number of Broken Wires
Distribution of Broken Wires
Location of Broken Wires
Condition of Wedge Socket
Damage
Corrosion

Individuals responsible for wire rope maintenance should be thoroughly acquainted with wear points, internal as well as external, to properly fulfill their duties

Lubrication

Need for adequate lubrication of wire ropes has been explained already. However, even though a wire rope has been properly impregnated with lubricant during manufacture, it should not be expected that this initial lubrication will last for the life of the rope.

The field lubrication practice to be followed depends upon the type of rope application. Ropes which are in continuous operation such as shovel hoist ropes, crowd ropes, retract ropes, counterweight ropes, and drag hoist ropes require frequent lubrication because the wires are constantly moving with respect to each other, both as a result of reversals of stress as well as from continual bending over sheaves and drums. On these applications a light oil has proven very effective in extending rope life. Penetration of the lubricant into the interior of the rope is necessary, and effective penetration cannot be obtained with heavy lubricants. Both the frequency and the method of application can vary from a practically continuous, automatic system on large strippers to regular but less frequent hand application on smaller machines. In any case, inspection should insure that these ropes are never permitted to become dry.

Benefits of lubricating drag lines have been debated pro and con for many years. Some recent results, however, indicate that the application of a light oil which will not pick up grit and dirt does improve the life of drag ropes appreciably.

Boom hoist ropes and boom support ropes, although they are not subjected to the same service activity as those on shovels and draglines, still require lubrication. Sections adjacent to sheaves or grooved shoes should be lubricated with both a light oil and a grease to prevent internal and external corrosion, as well as to reduce friction. The same is true of sections adjacent to fittings where vibrations are dampened.

Wear

Normal rope wear as a result of operating over sheaves and drums is a natural phenomenon and accordingly is to be expected. However, in order to extend rope life any operating condition which causes abnormal rope wear should be investigated with the objective of correcting or improving it. Rope inspection will provide the clue for tracing down the cause of the abnormal wear.

Operating conditions on shovels and draglines are far from static. Heavy loads and high digging speeds take their toll on all working parts. Consequently, when a marked change in wear characteristics of a wire rope is observed, an investigation to determine the reason is in order.

Wear of sheaves is one of the most common causes of abnormal rope wear. As a sheave groove wears and deepens, it also reduces in diameter. An undersize groove, because it does not provide proper working clearances, imposes a wedging action on the rope which results in heavy, uneven wear. This pinching action not only causes external abrasion, but also imposes internal wear, the results of which may be exceedingly detrimental to rope life.

Worn sheaves can cause wear to be imposed on the rope in sections some distance from the sheave. As the groove deepens from wear, the tread diameter of the sheave is reduced which results in the rope rubbing

across members which it would normally clear. The abnormal wear which results may be slight to begin with, but as the tread diameter continues to decrease it becomes an ever increasing factor in reducing rope life.

Fluted grooves, that is, grooves where the strands of the rope have worn an imprint, result from excessively high radial pressures for the sheave material used. The effect of these corrugated grooves is particularly bad on replacement ropes because the imprints may not match the length of lay of the new rope and as a result it rides the high spots. In addition to causing a scabby, uneven wear, the rough spots are apt to cause nicking and peening of the wires which can serve as focal points for the propagation of fatigue cracks. The remedy is a harder sheave, either through a change in material or heat treatment.

Sometimes the cause is not to be found in the sheave groove. Worn bearings, which result in sheave drag, cause relative movement between the rope and sheave especially during acceleration periods. The result is abnormally heavy wear on the crowns of the strands.

Flange wear, that is, the chafing which takes place when a rope rubs against the flange of a sheave upon entering and leaving the groove, is another abnormal wear condition. It can result from either bad sheave alignment or an excessive fleet angle. In the first case, the remedy is, of course, proper sheave alignment so that the rope enters and leaves the groove without interference. In the second case, if the fleet angle cannot be reduced, it is advisable to install a sheave with a more widely flared groove.

Rope Reversing

When one end of a rope is more heavily worn than the other, its life can be extended by turning the rope end for end. In order to obtain maximum benefits from such reversing, it must be done at the proper time, which will vary from one application to another. However, in all cases, the turning must be done before the worn end has deteriorated to the extent that it becomes the determining factor for rope removal a short time after reversal. Reversal of drag lines is universally practiced. Hoist ropes are reversed much less frequently, but on some shovel models it has been found well worthwhile.

On boom hoist ropes and bridles which are tied into the boom hoist reeving, wear concentration in sections adjacent to sheaves is quite common. This wear, which occurs in a very short section located at the points of tangency, is caused by a small amount of rope movement incidental to the "dancing" of the boom. The most effective remedy is to change the boom angle slightly so as to get a fresh section of rope at the points of tangency to the sheaves.

Broken Wires

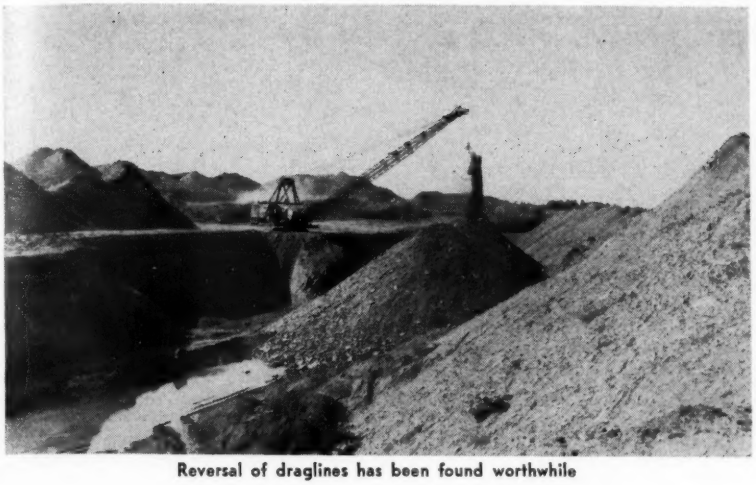
Broken wires in a rope result from the combined forces of bending and tension. The length of service before wire breaks occur depends upon the amount of wear on the rope, the severity of bending, the frequency of bending and the loads imposed. To put it another way, the heavier the wear, the smaller the sheaves and drums, the more numerous the sheaves in the reeving, the faster the rope speed, and the greater the loads, the sooner wire breaks will appear and the faster they will continue to develop. Improvement in any one of these factors will extend rope life. Here again, the benefits of a good field lubrication practice become evident because the stresses imposed on the individual wires will be kept to a minimum by reducing internal friction in the rope.

The decision as to when a rope should be removed from service is generally based on the number of broken wires which are present. However, the distribution of wire breaks has a marked effect upon the remaining strength of the rope. A concentration of breaks at one spot in a strand is a far more dangerous indication than are many more breaks distributed over a length of the rope. It is advisable to trim broken wires as soon as observed to prevent their damaging adjacent wires and thereby causing a concentration of wire breaks.

Broken wires in a rope can also occur from vibratory stresses, especially at spots where dampening consistently takes place, such as end fastenings. In such instances it is advisable to make regular cuts from the end of the rope, if possible, so as to change the dampened section. Such cuts should be made before the wire breaks become so numerous that distortion of rope structure, or complete rupture of one or more strands takes place. For example, the outer ends of drag lines consistently develop broken wires at the wedge socket and because these wire breaks frequently occur just inside the nose of the socket they are not easily discovered during inspection. Therefore, in addition to inspecting for broken wires, a regular cutting and reattaching program based upon experience with the particular machine involved is recommended to obtain maximum rope life.

Continuous vibration induced in boom support ropes and strands during digging results in fatigue of the component wires. Since boom support assemblies vary considerably in design, depending upon the size and make of machine on which they are used, the development and location of broken wires is also apt to vary considerably. However, regardless of de-

Wear of sheaves is one of the most common causes of abnormal rope wear. Here again, periodic inspection will go a long way towards rectifying the difficulty



Reversal of draglines has been found worthwhile

Boom support ropes also require lubrication

sign differences it is essential that these boom support assemblies have the strength necessary to support the front end of the machine. Consequently, it is imperative that the individuals responsible for boom support inspection and replacement be thoroughly acquainted with the locations at which wire breaks are most apt to occur. When boom support assemblies are taken out of service an examination should be made for internal as well as external wire breaks, especially in sections where dampening of vibration has taken place. The data obtained from these examinations should be used as a basis for determining the safe life which can be expected as well as the most effective inspection procedure for the particular shovel or dragline involved.

Condition of Wedge Sockets

In order to develop maximum holding power, wedge sockets must fit the rope properly. The impact loads imposed on shovel and drag ropes are not infrequently far in excess of the calculated stall loads. Consequently, if the holding power efficiency of a socket has been reduced as a result of socket wear, wire rope rupture is apt to occur at this attachment. In addition, the development of fatigue fractures in individual wires will be accelerated by a poor fit, which further lowers the holding power. Proper wedge and socket maintenance is most important if wire rope life is to be extended because it determines how much of the rope's strength can be utilized during digging. Therefore, it is advisable to inspect wedges and wickets whenever a rope is changed.

Conclusion

The effect of localized physical damage and corrosion on wire rope life has been discussed in detail earlier in this paper. It makes little difference if these abuses occur as a consequence of improper handling and storage, or careless equipment maintenance, they still reduce wire rope life. Conversely, the correction of abuses which cause injury to a wire rope, and the prevention of corrosion have a noticeable influence in extending wire rope life.

The significant benefit that is derived from a comprehensive inspection and maintenance procedure is that rope life can be safely extended. Through proper care the hazard of unexpected failure can be largely eliminated, and the consequent expensive shutdown of equipment avoided. The end result is reduced mining costs.

The decision as to when a rope should be removed from service is generally based on the number of broken wires which are present

THE COAL INDUSTRY OF THE USSR

In March 1956, the Soviet Minister of Coal Industry suggested to Britain that there should be an exchange of technical visits between the industries of the two countries. Since little was known about the coal industry in the USSR, the British decided to send a technical mission of specialists from the National Coal Board staff. This article summarizes the report made by the technical mission on "The Coal Industry of the USSR," which is based on conditions in Russia at the time of the team's visit—May 14 to June 7, 1956. Copies of the team's report are available from the National Coal Board, London, England.

Russia is currently placing much emphasis on advancing its coal mining industry. In the current five-year-plan, she has approved an expansion of coal production to the extent of about 200,000,000 tons. Men and materials are being provided to the coal industry in high priority. Basic research on mining problems and developments of new types of equipment are being carried out.

To understand the problems involved, one must consider the natural conditions in that country. It is of immense size, being more than 5000 miles from east to west and more than 2000 miles from north to south. Communications are difficult, reliance being placed on the railways for the movement of bulk traffic such as coal. There are large stretches of virtually uninhabited country and the general standard of living conditions is substantially lower than in Britain.

Organization

Responsibility for operating the collieries and their associated activities is vested in the Ministry of Coal Industry. Detailed planning, reconstruction and new construction is handled separately by the Ministry of Colliery Construction.

It is of interest to note that the Ministry of Coal Industry also has a wide range of extraneous matters to handle, including the running of housing estates, kindergarten and nursery schools, technical schools and research institutes.

Outside the Ukraine the main management functions are discharged through regional Combinats which are, in turn, divided into groups of collieries in Trusts. In the Ukraine, there is a Ukraine Ministry of Coal Industry under which are four regional Departments being responsible for groups of Trusts.

The Ministry of Coal Industry, in addition to its responsibility for current production, must prepare plans for the development of the industry as a contribution to the general five-year plans for the State as a whole. The Combinats and the Ukraine Ministry prepare the initial plans for the areas which they control and submit these to the Ministry for co-ordination and approval. The Trusts play little part in this overall planning, their responsibility being confined to the management of the collieries and the technical and welfare activities.

Production

The ten major and many minor coal fields in the USSR produced in 1955 a total output of 391,000,000 tons. Of this about 319,000,000 tons was bituminous coal—7,500,000 being open pit production. Together with a lignite open pit production of 57,500,000 tons, this output was the responsibility of the Ministry of Coal Industry. A further 14,500,000 tons, mostly lignite, is produced from small mines which are operated, in some cases, by local councils.

Reserves proved to date are quoted as 630 billion tons of bituminous coal and 118 billion tons of lignite. Further exploration will undoubtedly increase these figures.

A substantial percentage of the reserves is contained in strata that lies less than 1200 ft below the earth's surface. Seam thickness varies considerably. In one coal field the thickness of seams worked varies from 2½ to 50 ft. In cases of high grade coking coal, which is not plentiful, seams as thin as 16 in. are mined. Outbursts of coal and gas are a major problem and spontaneous combustion is common to a number of seams and requires special precautions. A lot of water is encountered in some coal fields.

Methods of Working

Mine layouts are simple, straightforward and easy to operate. In flat or gently-inclined seams, in-the-seam mining is customary, but, in some recent planning, semi-horizon-mining methods are employed. The single-unit panel is almost universal.

In folded or inclined strata, horizon or semi-horizon-mining systems are employed, the normal vertical distance between horizons being of the order of 240 to 300 ft. Gradients are designed for locomotive haulage and to provide for drainage of all water to pit bottom.

Collieries are normally ventilated by exhausting fans and the fan-drift water gauge may be as high as 12 in.

Mechanization to date has increased face OMS (output per man shift) by

35 percent. This figure is low compared with results from mechanization in other countries and cannot have been a sound manpower or financial investment. Ultimate policy in the USSR is to mechanize all heavy manual operations.

Preparation of coal for the market does not play a great part in the industry and is normally restricted to coking coals. Domestic fuels are said to contain up to 45 percent ash. Extension of coal preparation facilities is reported to be contemplated.

Some of the mining methods used are listed below:

(1) Longwall Advancing—It is at present the commonest method of working and accounted in 1955 for 52.3 percent of the output. The aim of the Soviet mining engineers is to greatly increase average face lengths during the present five years and research is proceeding to this end. It is clearly the intention to pursue a policy of increasing bulk output per unit, and thus the development establishments are working on the production of a suitable face conveyor, particularly the heavy-armored-chain type.

(2) Longwall Retreating—The percentage of coal produced by longwall retreating workings in 1955 was 30.8. The agreed policy is substantially to increase production by this method of work. The aim is to increase the percentage of retreating faces to 60 percent by 1960 at the expense of longwall advancing.

(3) Steep Seams—Substantial tonnages will continue to be produced from steep seams. Several ingenious devices have been applied to these conditions—in particular, the hydraulic shield supports developed specifically for seams of more than 35° inclination. The shield system makes possible a high face OMS—in the region of 50 to 60 tons per man shift—but this may well be reduced to 2.2 tons overall. Development with the shield-support method is expensive—transportation of heavy shield equipment to neighboring units being particular costly. A girder shield system is in use in the thicker sections, and normal continental practice of "slicing," in conjunction with pneumatic stowing and formation of artificial plank roof is successfully operated.

(4) Room and Pillar Work—This system is not extensively used and represents only 0.6 percent of the total output. It is, however, an essential feature of the hydraulic technique now coming into operation, and with the development of the many hydraulic mines proposed during the next five years, it is probable that this percentage will increase. The percentage is also likely to be affected by the consideration now being given to expansion of mechanization in narrow work. The manner in which roadways stand, especially those supported by pillars, coupled with the lack of evidence of advance weight on roadways where retreating longwall is practiced at relatively shallow depth, would suggest that mechanized narrow work on the American pattern might give high productivity.

Planning

The Soviet mining industry is developed in close accordance with the national economic plan, consideration being given to the demands of other industries, the capacity of the collieries and the requirements of coal consumers.

The broad tentative plan for development is worked out by the Ministry of Coal Industry and submitted to the Government for approval. Once the general program is agreed upon, the detailed planning of individual schemes is carried out by the Ministry of Colliery Construction, which is responsible for the planning of collieries, open pit mines, preparation and briquetting plant and all other undertakings of the coal industry.

Of special interest is the use of standard plans. The large extent of colliery construction since the War, and which continues to increase year by year, has meant that the planners have had great difficulty in keeping up with the rate of development. This problem has been solved by standardizing various individual elements of colliery development, or sets of elements, and in some cases even complete collieries. The introduction of such standards has materially reduced the volume of planning work necessary for the development of individual new collieries and reconstructions and has substantially reduced the time required for the preparation of plans—all the necessary drawings are available before construction work is begun.

Underground Mechanization

Face. Considerable effort has been put into the development and application of machinery for face work (coal and rock). This activity has, for the most part, been concentrated on power loaders, and the improvement of conveyors and roof supports has not been kept in pace. Of the output from seams with a gradient less than 35°, which represents 85 percent of the total output, 35.8 percent was power-loaded in the first quarter of 1956.

All the machines in use are cutter loaders of one kind or another and there has been little success so far with ploughs, though their development is proceeding. (Keep in mind that most Russian mining is longwall.) The development of machines for steep seams is also well advanced and there are some available and working in seams of the order of 70°.

Most of the face power loaders in use are based on the frame-jib design, the basic machine being the Donbass cutter loader. There are many variants of this design most of which are suitable only for soft coal, but recently machines have been developed which appear suitable for harder coals.

The mechanization of thin seams is well established and suitable machines are available for both the soft and hard coals.

Statistics indicate that the average monthly output per power loader (all types) is 5302 tons. As a 30-day month is worked, this represents a daily output of about 175 tons. The equivalent figure for Donbass cutter loaders is 214 tons and for thin-seam (below 2 ft 6 in.) machines, 106 tons. Although most of the machines are basically cyclic in operation, they are worked in practice almost continuously, one shift carrying on where the previous one left off, with all shifts capable of doing any of the jobs on the face.

According to the British Technical Mission, the face OMS on the British basis was in the region of three to four tons (Soviet face OMS figures do not include labor in roadways, making comparison difficult).

Development Work. Two machines of the cutter-loader type have been developed for entry work and experiments with them are proceeding now. Coal and rock loading machines similar in design to British and American types are utilized.

Tunneling Machines. The development of tunneling machines is well advanced, one of the reasons being that far more longwall retreating work is planned for the future. The existing machines are suitable only for softer rock and coal, where they are doing exceptionally good work. They use a simple rotating head (6.6 rpm) fitted with fixed cutting bits and breaking cones, and excavate a tunnel ten ft in diameter (sometimes more), trimming the sides by separate drum cutting heads so that straight-sided arches can be used. Buckets on the cutting head gather the cut material and deliver to a central 24-in. conveyor at the top of the machine which, in turn, delivers into mine cars at the rear. The machine jacks itself to the sides of the tunnel and walks forward hydraulically with a 30-ton thrust, carrying its own temporary support in the form of spring-steel bars which press against the roof and sides of the tunnel.

A hard-rock tunneling machine is being developed but is still at the experimental stage.

Support. Face supports are mostly of wood and there are some friction props (reported to have a resistance of 50 tons). Most roof bars are of wood. No mention was made of the use of roof bolts.

Many roadways, both in rock and in the seams, are timber lined. Research

work is being devoted on a large scale to the provision of suitable reinforced pre-stressed concrete props and bars. This medium of support is being rapidly extended. Yielding steel arches are in use, and a few examples of standard two-piece arches are also to be observed.

Underground Transport. Of the current stoppages of work at the coal face, some 25 percent of time lost is said to be attributed to inadequate haulage facilities. Bigger locomotives and more large mine cars have failed to solve the problem, and there is a real indication that Soviet mining engineers are about to embark on a concerted drive towards mainline conveyors.

Face conveyors are mostly of the scraper-chain variety. Very few other conveyors are now employed and those used are of the standard semi-troughed belt type. The locomotive systems employ electric battery and trolley types exclusively. In some mines, specially-designed mono-rail installations are used for the transport of supplies.

Hydraulic Mining

In connection with underground mechanization, Russian experiments with hydraulic mining is worthy of special mention. Briefly, the aim of the hydraulic mining system is to remove the coal from the face by high-pressure water jets and transport it hydraulically from the place of work right to the surface. It is a simple and impressive system, and the production envisage by the Soviet engineers exceed those in any other known form of underground mining. Experiments are now proceeding with nozzle pressures up to 200 atmospheres (about 3000 psi) and work is taking place at a research institute with pulsed jets having pressures up to 1200 atm (about 18000 psi) in an attempt to tackle rock and develop a hydraulic extraction system for tunneling work.

At the experimental hydraulic drift mine visited by the British team, a room and pillar system is used. Narrow entries, 40 to 60 ft apart, are driven 450 to 540 ft to form pillars which are later extracted on the retreat. In most cases the coal is first loosened by long-hole pulsed infusion. The holes are drilled so that half the width of adjacent pillars is taken from each entry. The pillars are extracted in lifts 15 to 20 ft long. High-pressure water jets are directed on to the loosened coal to remove it from the face. The coal and water flow down the entries in steel flumes laid on the floor to a sump, first passing over a bar screen and a swing-hammer crusher which reduces all the coal to below 2.36 in. size. Low pressure primary pumps transfer the coal to the main pumps at the drift bottom, from where the mixture is pumped direct to the preparation plant.

In considering the application of this system, one must bear in mind the limited size of coal which can be transported hydraulically and the difficult and unpleasant working conditions created by the large quantities of water employed.

Although development work will continue, hydraulic mining in the USSR is now passing from the experimental stage to that of wide-scale application.

Power

At no colliery visited by the British team was there any mine power station. At the all-electric collieries the supply was brought in from the public network. In view of the long hauls for the coal to some of the electricity stations, it is difficult to understand why this policy is adopted, as it would seem to be more economical to generate electricity at the mine.

Normal distribution voltage underground is 3.3 kv, although higher voltages are being considered. The secondary voltage is at present 380 v, but a decision has been taken to increase this voltage to 660 v. Flameproof transformers are not so far in use, except for lighting circuits. The normal system of distribution is with the neutral insulated or connected to earth through a known impedance.

Mining Research

Facilities for mining research and development work are on a massive scale in the USSR. Some mining research is also done at the universities and mining institutes. However, it is doubtful whether the results of their work, particularly on the research side, is being applied in the field.

Development of machines is also carried out on a very considerable scale. A special effort is being made to design and create coal face equipment to meet varying conditions. Some of the designs are quite original; others are obviously copied from Western Europe and America. But as in the case of the research institutes, application at the coal face of this new equipment seems slow.

Wages and Welfare

The level of wages in the USSR coal mining industry is higher than in other industries. Earnings of most miners are, however, determined by their skill and effort. Piecework prevails in the industry, and all performance above the norm is paid for above the basic rate; any outstanding productivity brings not only monetary reward but increased cultural and other facilities for the worker. There is no minimum wage for pieceworkers.

Great emphasis is placed on social welfare, not only in regard to the well-being of the miner himself but also in respect of his wife and family, these facilities being provided and maintained by the Ministry of Coal Industry. All social welfare premises are erected and equipped by the Ministry of Colliery Construction.

Education and Training

Higher education in all branches of technology is considered very important in the USSR and great progress has been made, particularly in recent years. It is provided at four main types of educational institutions—universities, technical institutes, secondary technical schools or technicians and special colleges. Part time and full-time refresher courses are also given.

Training of junior officials, craftsmen and skilled workers generally is given great attention, responsibility for training resting with the Ministry of Coal Industry. Courses given at the collieries range from preliminary training for new entrants to refresher courses for supervisory grades.

General Impressions

Some of the general impressions gained by the British Technical Mission are briefly listed below:

(1) Technical education for the coal mining industry was impressive, as were certain facets of its research and engineering development programs.

(2) The industry had a relatively low standard of living, even in privileged communities. Poor housing, lack of sanitation, absence of roadways, and inadequate transport were noticeable.

(3) With the immense coal reserves, at shallow depth in most coal fields, there is enormous scope for expansion of coal production.

(4) The equipment of technical schools and colleges by the Ministry of Coal Industry was on a lavish scale, modern, and gave an excellent background for the narrow form of technical education being provided. The number of students passing out each year into the coal mining industry was stated to be 4000 of about university standard, and 13,000 approaching British Higher National Certificate standard.

(5) Research institutes and engineering establishments, under the control of the Ministry of Coal Industry, seemed to be adequately manned, but it was doubtful whether the results of their work were being properly applied in the field.

(6) The experimental hydraulic mining system and the shield mining system for thick, steep seams were examples of original thought and courageous application.

(7) It was obvious that the Soviet Union, in approving an expansion of coal production, was placing considerable reliance on coal to help meet the country's future energy demands.

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GEOLOGICAL ASPECTS OF MINE ROOF ACTION AND CONTROL

By G. R. SPINDLER
and
D. T. WORRELL

A report of the Committee on Roof Action showing supporting strength of roof bolt anchorage as related to installation torque and the characteristics of the anchorage strata

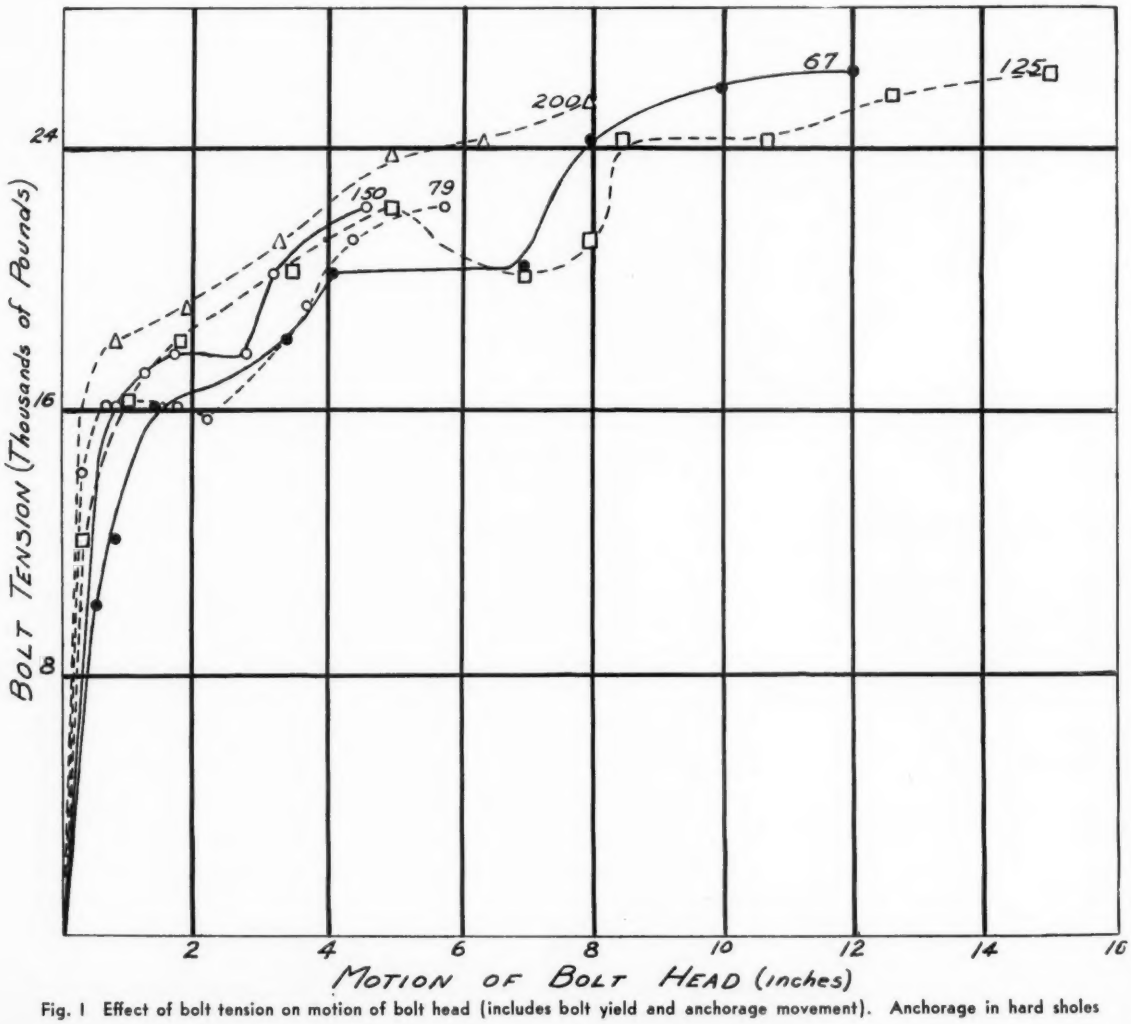

Fig. 1 Effect of bolt tension on motion of bolt head (includes bolt yield and anchorage movement). Anchorage in hard sholes

THE studies sponsored by the Committee on the Geologic Aspects of Mine Action are designed to correlate field data with respect to the rigidity and supporting strength of roof-bolt anchorages in materials of varying degrees of hardness and stability with variations in the torque applied to the bolts in their original installation. Some of the tests reported were made by committee members but the majority represent tests made by roof bolt inspectors of the West Virginia Department of Mines who, in most cases, worked with corresponding representatives of the United States Bureau of Mines.

The purpose of this report is to stimulate interest among coal companies, state and federal agencies in establishing anchorage strengths for roof bolts in various classes of strata. Before any definite figures can be recommended, such strengths must be substantiated by numerous field tests. This preliminary report covers experiments already conducted.

The field data included in tables No. 1 and No. 2 are applied principally to the Pittsburgh coal seam in northern West Virginia under conditions which permit bolt anchorage in the firm "black rock" in some areas but requires anchorage in rather soft shales in other areas where the "black rock" is nonexistent.

It is recognized to be difficult to establish precise patterns in such tests because of the relative impossibility of obtaining exact duplication of bolt installations, even in adjacent holes in the same strata. Under such conditions the sampling must include a large number of individual tests and that, of course, will require time. The data reviewed do, however, appear to establish or verify certain principles that are indicated by earlier laboratory and field tests and are given with that point in mind.

It is considered important that strata supported by roof bolts be held

ROOF BOLT PULL TESTS

Table 1

Hard Shale Anchorage

Test No.	Bolt Size	Torque Ft Lb	Pull in Pounds for ⅛" Displacement	Displacement Inches for 8000 Lb Pull	Seam
1	¾" x 72"	80	8,000	0.125	Pittsburgh
2	¾" x 72"	150	9,500	0.065	"
3	¾" x 72"	125	10,800	0.065	"
4	¾" x 72"	66	6,000	0.310	"
5	¾" x 72"	200	12,000	0.060	"
6	¾" x 72"	130	7,600	0.183	"
7	⅝" x 66"	130	6,800	0.280	"
8	⅝" x 66"	130	6,700	0.277	"
9	⅝" x 66"	190	11,600	0.025	"
10	⅝" x 66"	180	10,200	0.050	"
11	¾" x 72"	185	11,800	0.022	"
12	⅝" x 72"	190	12,400	0.025	"
13	⅝" x 72"	220	12,300	0.042	"
14	¾" x 72"	150	7,600	0.146	"
15	⅝" x 48"	150	8,000	0.125	Pocahontas #4
16	⅝" x 48"	170	10,600	0.035	"
17	⅝" x 30"	190	9,500	0.060	Stockton
18	⅝" x 30"	170	11,200	0.034	Red Stone
19	⅝" x 30"	170	11,600	0.046	"
20	¾" x 30"	230	10,000	0.062	"
21	¾" x 36"	160	9,500	0.090	"
22	¾" x 30"	160	9,000	0.054	"
23	⅝" x 30"	180	10,500	0.044	"
24	¾" x 66"	150	9,000	0.069	Pittsburgh
25	⅝" x 60"	150	10,200	0.061	"
26	⅝" x 48"	240	12,000	0.035	Sewickley
27	⅝" x 48"	180	10,000	0.050	"
28	⅝" x 48"	170	10,000	0.035	"
Average Values		66	6,000	0.310	
		80	8,000	0.125	
		130	7,975	0.201	
		150	8,980	0.093	
		160	9,667	0.063	
		170	10,850	0.038	
		180	10,667	0.041	
		190	11,100	0.037	
		200	12,000	0.060	
		220	11,433	0.046	

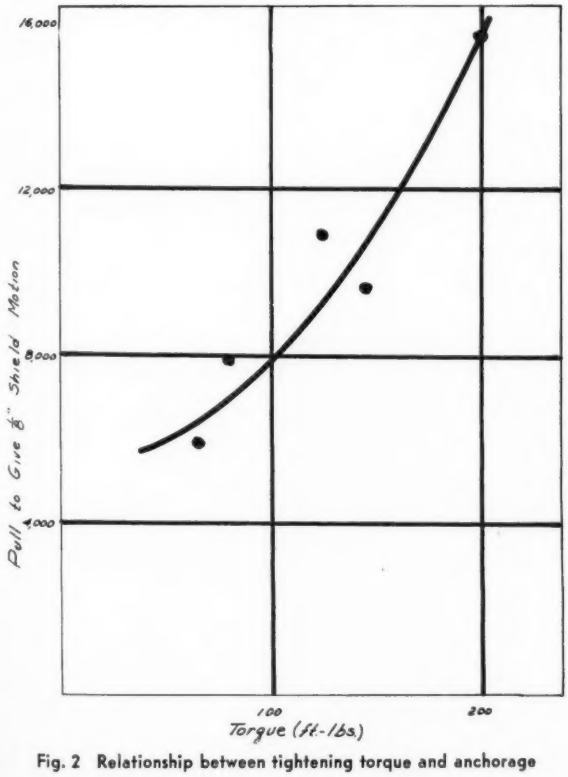

Fig. 2 Relationship between tightening torque and anchorage

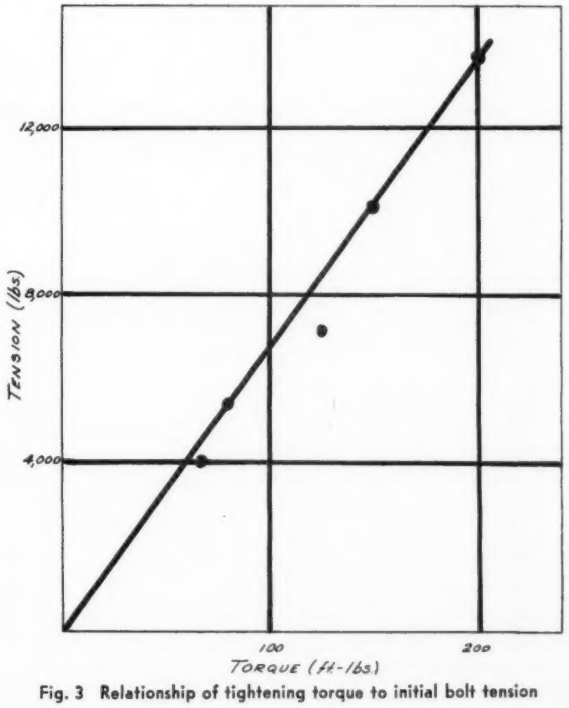

Fig. 3 Relationship of tightening torque to initial bolt tension

Table II
Soft Shale Anchorage

Test No.	Bolt Size	Torque Ft Lb	Pull in Pounds for 1/8" Displacement	Displacement in Inches for 8000 Lb Pull	Seam
1	3/4" x 60"	170	13,500	0.030	All
2	5/8" x 60"	170	15,000	0.020	tests
3	5/8" x 60"	160	15,000	0.020	were
4	3/4" x 60"	160	14,000	0.030	made
5	5/8" x 60"	170	13,000	0.025	in
6	5/8" x 60"	150	14,000	0.065	the
7	3/4" x 60"	160	8,500	0.091	Pittsburgh
8	5/8" x 60"	220	12,000	0.039	seam
9	5/8" x 60"	200	11,400	0.050	
10	5/8" x 60"	190	12,000	0.050	
11	3/4" x 60"	170	9,200	0.080	
12	5/8" x 60"	140	12,000	0.035	
13	3/4" x 60"	150	11,900	0.050	
14	5/8" x 60"	170	9,200	0.045	
15	5/8" x 60"	200	10,200	0.056	
16	3/4" x 60"	140	8,400	0.099	
17	5/8" x 60"	140	9,500	0.076	
18	5/8" x 60"	130	6,600	0.205	
19	5/8" x 60"	150	16,000	0.050	
20	5/8" x 60"	150	14,000	0.060	
21	3/4" x 60"	160	12,500	0.060	
22	5/8" x 60"	150	12,500	0.060	
23	5/8" x 60"	170	13,500	0.060	
24	3/4" x 60"	170	13,500	0.065	
25	3/4" x 60"	170	10,000	0.032	
26	5/8" x 60"	70	6,500	0.205	
27	5/8" x 60"	140	9,500	0.089	
28	3/4" x 60"	150	9,200	0.066	
29	5/8" x 60"	180	7,600	0.162	
30	5/8" x 60"	130	10,200	0.045	
31	5/8" x 48"	170	8,400	0.093	
32	5/8" x 48"	190	9,000	0.063	
33	5/8" x 60"	160	8,000	0.093	
34	5/8" x 60"	150	8,500	0.094	
35	3/4" x 48"	120	6,000		
36	5/8" x 60"	160	10,200	0.060	
37	3/4" x 60"	170	10,200	0.060	
38	5/8" x 60"	170	8,500	0.093	
39	5/8" x 60"	160	8,600	0.093	
40	5/8" x 60"	150	9,000	0.064	
41	3/4" x 60"	150	7,200	0.066	
42	5/8" x 60"	180	7,600	0.162	
43	5/8" x 60"	130	10,200	0.042	
44	5/8" x 48"	140	9,000	0.067	
45	3/4" x 48"	130	4,000	0.436	
Average Values		120	6,000		All
		130	7,750	0.182	tests
		140	9,680	0.069	were
		150	11,630	0.066	made
		160	10,970	0.064	in
		170	11,270	0.055	the
		180	7,600	0.162	Pittsburgh
		190	10,000	0.054	seam
		200	10,800	0.053	

rigidly in place and that the first movement of the strata is critical in obtaining good roof support. It has been observed that this point of first or small yield is not always very closely related to the maximum resistance to withdrawal of the bolt or the maximum supporting strength. This initial stability of the installation appears to be closely related to the original torque or bolt tension applied when the bolt is installed with the resistance to first movement increasing with the applied torque. These relationships are shown by the curves in figure 1.

Table I indicates that for anchorages in hard shale, or sandstone, the optimum torque may be of the order of 170 foot pounds, with the increase in stability establishing a fairly flat curve for torques above that figure.

Table II indicates that for anchorages in relatively soft shales the optimum torque may be at a somewhat lower level, about 150 to 160 foot pounds.

In both tables the displacement of the shield for uniform loadings of 8000 pounds is given as an indication of the capacity of the bolts to withstand normal loading without excessive or prohibitive displacement.

In general, there appears to be no real advantage in applying torques or bolt tensions in excess of the optimum indicated as these limits approach the yield point of the bolts in common use.

Roof bolt pull tester—it is considered important that strata supported by roof bolts be held rigidly in place and that the first movement of the strata is critical in obtaining good roof support

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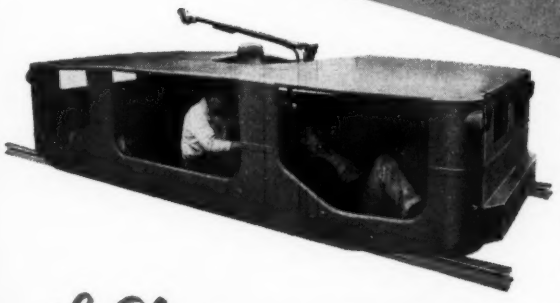

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As Viewed by HARRY L. MOFFETT of the American Mining Congress

TORRID temperatures in Washington are not confined to the weather but have spread rapidly to the Federal lawmakers. The House, after heated debate, has stamped its approval on civil rights legislation sought by the Administration and the measure, through an unusual parliamentary maneuver, is now on the Senate calendar. The bill may be the subject of prolonged debate, even to the extent of filibustering by Southern Democrats, who have traditionally opposed any such legislation. The combination of hot weather and hot tempers is likely to make it difficult to obtain the passage of many legislative proposals which otherwise might reach the White House before adjournment.

Only on one major facet of the Administration's legislative program has Congress made speed, and that is in delivering appropriation measures to the President. At this writing, Congress has approved eight of the thirteen major appropriation bills. It has still to act on funds for defense, foreign aid, public works, atomic energy, and the Interior Department. Reductions in the requested appropriations now exceed $4 billion, although a good portion of this slash is in the form of "paper" reductions, involving funds which may have to be appropriated next year.

The fiscal policies of the Administration are under heavy fire from members of the Senate Finance Committee, headed by Senator Byrd (Dem. Va.). Treasury Secretary Humphrey has testified that the Administration's policies have resulted in debt cuts and balanced budgets, while Byrd and some of his colleagues have contended that the present spending and tax policies are inflationary and oppressive to the average citizen.

Most observers now believe there is little chance of Congress' approving United States participation in the Organization for Trade Cooperation (OTC), despite the President's five requests for such action at this session. Opposition to OTC and the General Agreement on Tariffs and Trade, which it would administer, has been rising steadily as more and more domestic industries have been hit by heavy imports of foreign produced articles.

Minerals Program Offered

On June 4, Interior Secretary Seaton unveiled the Administration's recommendations for a long-range minerals program. Awaited by Congress for over two years, the proposals were greeted with mixed feelings by Western Congressmen and Senators.

Principal features of the program as outlined by Seaton include: intensification of minerals research, expansion of geologic mapping and investigations into newer methods of prospecting, study and possible revision of the mining laws to encourage the use of geophysical exploration techniques, permanent extension of the activities of the Defense Minerals Exploration Administration, establishment of a system of incentive bonus payments for beryl, columbium-tantalum, and chromite to take effect when current purchase programs terminate, and protection for domestic producers of lead and zinc in the form of sliding-scale import excise taxes.

Congress and the mining industry were quick to express their approval of the Administration's recommendation for an import excise tax, the first such recognition given a domestic industry in over two decades. As to the remainder of the proposals, Western members of Congress were rather outspoken, stating in general that they would accomplish little toward maintaining a strong domestic minerals industry.

The lead-zinc import tax plan (to be substituted for existing tariff duties) would operate as follows:

(1) As to *lead*—when the average price of lead for any calendar quarter is 17 cents per pound or more, all import excise taxes would be suspended. When the average price for any quarter is 16 cents but less than 17 cents, an excise tax of 1 cent per pound would be invoked; when the average price for a quarterly period is 15 cents but less than 16 cents, an excise tax of 2 cents would go into effect, and when the price falls below 15 cents the tax would be 3 cents. For lead-bearing ores, flue dust, and mattes, an excise tax of one-half cent per pound of lead content would go into effect when the average price is 16 cents but less than 17 cents; when the average price is 15 cents but less than 16 cents a one and one-quarter cents tax would be invoked, and when the average price falls below 15 cents, a tax of 2 cents would become effective.

(2) As to *zinc*—All import excise taxes would be suspended when the average price zinc for any calendar quarter is 14½ cents or more; when the price is 13½ cents but less than 14½ cents, a one-half cent tax per pound would be imposed; when the price is 12½ cents but less than 13½ cents, the excise tax would be 1¼ cents; and below 12½ cents, the tax would be 2 cents. In the case of zinc-bearing ores and concentrates, whenever the price is 13½ cents but less than 14½ cents the tax would be 0.4 cents per pound of zinc content; when the price is 12½ cents but less than 13½ cents, the tax would be 1.1 cents;

★ ★ ★ ★ ★ ★ ★

Washington Highlights

MINERALS PROGRAM: Before Congress.

TAX REDUCTION: Seen for next year.

PRICE DISCRIMINATION: Bill before Senate Committee.

BARTER PROGRAM: Restrictions under fire.

MINERALS PURCHASE: Funds refused.

OIL IMPORTS: Cabinet Committee to study.

METAL MINE SAFETY: House hearings held.

LABOR HEARINGS: Under way in both Houses.

★ ★ ★ ★ ★ ★ ★

and at less than 12½ cents the tax would be 1.8 cents per pound.

For lead and zinc pigments, sheets and other products, graduated import taxes would be imposed, at rates intended to be equalized with those applicable to the metals. All prices would be based on E.&M.J.'s reported average price for a calendar quarter for common lead, New York, and Prime Western zinc, E. St. Louis.

Seaton said that this proposal would provide more adequate protection to domestic producers of lead and zinc without at the same time materially restricting needed imports.

The Interior Secretary ticked off a list of other minerals and metals on which he said special programs are not now justified because of decreased demand, higher consumption, significantly increased world supplies in the near future, continuing good prices, negligible domestic production, or current Government purchase programs. The minerals he mentioned included antimony, barite, boron, cobalt, copper, fluorspar, gypsum, iron ore, magnesium, manganese, mercury, mica, molybedenum, nickel, phosphate rock, potash, sulphur, tin, tungsten, sand and gravel.

Measures to carry out the Interior Department's recommendations have been submitted to the House and Senate and have been formally introduced.

Domestic producers of lead and zinc have met and formed an Emergency Lead-Zinc Committee to work with Congress and the executive departments in connection with the import excise tax proposals. Charles E. Schwab has been named chairman of the new Committee. Western Senators and Congressmen are cooperating closely with the Committee in seeking early hearings and action on the pending measures.

A Tax Cut Next Year?

Influential members of Congress continue to voice the opinion that personal income taxes will be reduced next year despite the Federal fiscal situation.

House Speaker Sam Rayburn (Dem. Texas) has urged adoption of a bill to cut taxes. He has said that the revised budget picture "doesn't do anything" to dampen plans of the majority party to enact a tax slash. Rayburn commented, "maybe we won't have a bill until next year but it will be effective January 1."

This positive statement, together with remarks by Chairman Byrd (Dem. Va.) of the Senate Finance Committee as to the oppressiveness of high taxes, are taken by observers to mean that a tax cut is in the offing for next year. Administration spokesmen have tried to forestall any such action by calling for a substantial reduction of the Federal debt before any consideration is given to tax reduction. Next year being an election year, however, politics will probably govern and a tax cut may be voted.

Currently under way in the House Ways and Means Committee is a study by a subcommittee headed by Rep. Wilbur Mills (Dem. Ark.) to develop all the facts on the Federal budget and the outlook for future tax cuts.

Meanwhile, after two years of study, the Ways and Means Committee sent a comprehensive measure to the House calling for numerous technical changes in existing excise taxes. The House promptly approved the bill and it is now in the Senate Finance Committee. It is not expected to be taken up by the Senate before next year. While the measure would eliminate many inequities in excise taxes and simplify many of the technical provisions, it would not reduce the transportation tax on property which has proven so burdensome to the mining industry.

Pricing Bill Advances

The so-called price discrimination bill, S. 11, has inched its way forward in the Senate. Late in June, the Antimonopoly subcommittee of the Senate Judiciary Committee voted to report the measure to the full committee, but did so without endorsing or disapproving it. The subcommittee, however, did tack on an amendment which would permit a seller to offer a lower price to meet the lower price of a competitor "unless the evidence affirmatively shows" that the effect may be to substantially lessen competition or create a monopoly. The committee also made it plain that the bill should remain open to amendment without restriction.

The measure, which has as its objective the elimination of the "good faith" defense in lowering prices to meet the equally low price of a competitor, would cast doubt on the legality of long-established freight-absorption practices. It may be taken up by the full committee at any time.

The House Judiciary Committee, which has a similar bill before it, has not yet taken any action on it.

Meanwhile, the measure which would require 60-days prior notification to the Attorney General and the Federal Trade Commission of proposed corporate acquisitions or mergers is still lodged in the House Rules Committee. That committee held hearings in late June, and expressions of the members indicate that the bill may be bottled up for the session.

Barter Program Under Fire

The Department of Agriculture's newly-revised program of bartering surplus agricultural commodities for strategic minerals and materials abroad has come under heavy fire from metals brokers and grain trading companies. Recently the Department revamped the program and placed certain restrictions on its operation which brought forth a storm of protest. Under the new program, minerals and materials of foreign origin obtained in exchange for surplus agricultural commodities must be processed abroad (heretofore they were processed mainly in the United States), and certain agricultural commodities may not be exported under barter contracts without a special showing that the proposed exchange will result in a net increase in U. S. exports of these commodities.

The Senate Agriculture Committee held hearings late in June on the barter program. Spokesmen for metal brokers and grain traders urged that the restrictions placed on the program in the latest revision be removed. They also called for expansion of the program to include the barter of agricultural products for all of the 74 minerals and materials contained in the strategic materials stockpile list.

Prior to the hearings, the American Mining Congress and domestic producers of lead and zinc had made plain their dissatisfaction over the restriction requiring minerals of foreign origin to be processed abroad.

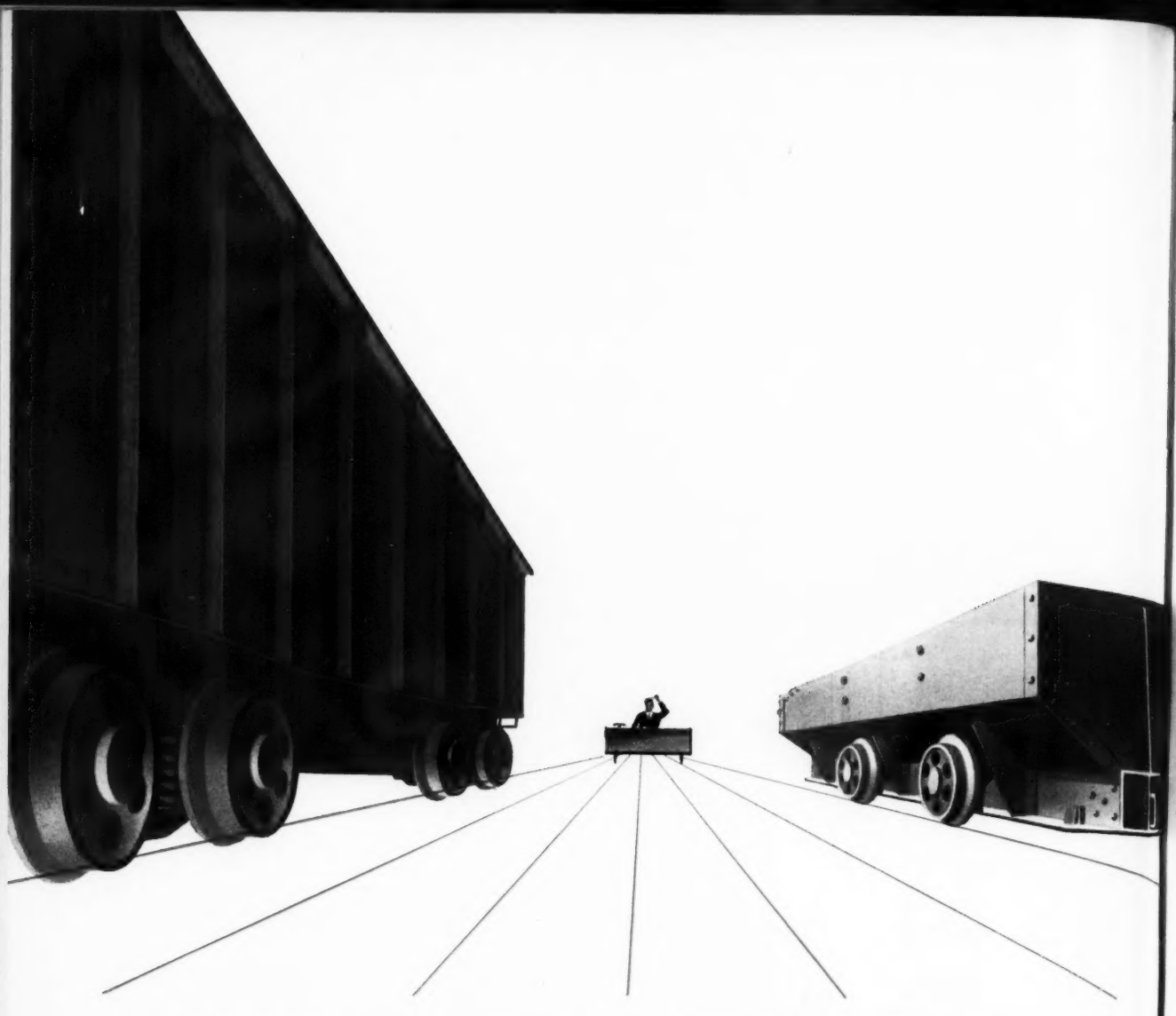
Interior Secretary Seaton has also called for removal of this restriction and has told representatives of the press that he was urging the Administration to take such action promptly. Agriculture Secretary Benson, however, stated that the barter program was not intended as a means of propping up domestic mining, and indicated that he was not sympathetic to moves to change the program to benefit mineral stockpiling.

Minerals Purchase Funds Refused

Repeated strong efforts of Western Congressmen and Senators to obtain funds to continue the domestic purchase programs for asbestos, tungsten, fluorspar and columbium-tantalum have run up against heavy opposition in Congress. The House has gone on record that it is opposed to granting funds for continued procurement of tungsten and columbium - tantalum, and appropriations measures have been sent the White House without any money for these programs, despite the fact that Congress authorized their institution at the last session when it adopted what later became Public Law 733.

The House has given way in its opposition to funds for the continuation of the purchase programs for domestic fluorspar and asbestos, and during the debate on the last supplemental appropriation bill opponents of tungsten-buying asserted that they

(*Continued on page* 81)



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AMC Personals

Horace Y. Bassett, executive vice-president of Calumet & Hecla, Inc., has succeeded **Endicott R. Lovell** as president and chief executive officer of the company. Lovell, president for 13 years, had reached the company's normal retirement age, and was named chairman of the board and chairman of the executive committee.

H. Y. Bassett

E. R. Lovell

Bassett joined Calumet and Hecla in 1942 when the company acquired the Wolverine Tube Co. of which he was factory manager. He became general manager of Wolverine Tube Division of C & H in 1944 and a vice-president of the company in 1948. He was elected executive vice-president last year.

Lovell's career with C & H began in 1919 when he worked during college vacation periods. He became assistant superintendent of the smelting works in 1923 and a superintendent 10 years later. After serving as general superintendent and general manager he was made a vice-president and director in 1943, succeeding to the presidency the following year.

Following his election as president, Bassett announced the election of **Francis J. Gibbons** as treasurer, and **Arthur E. Toy** as controller of C & H. It was also announced that **Colin J. Andrews**, assistant treasurer, has been appointed assistant controller.

In the Calumet Division of C & H, A. S. Kromer, vice-president and general manager of the division, announced that **George F. McKereghan** has been named branch manager of C & H's uranium operations in New Mexico. **John H. Doyle** was named office manager.

William P. Chamberlain has joined Cherry Hill Coal Corp. as vice-president in charge of finance. He will also be responsible for part of the sales and operating activities of this producer and shipper of bituminous coals. Chamberlain returns to the coal industry after two years with the F. C. Russell Co. as credit executive. For 25 years he was associated with the Cleveland-Cliffs Iron Co., leaving that company in 1955 when Cliffs sold its coal division.

The appointment of **Robert H. Merrill**, manager of materials at the General Electric Company's wire and cable department, Brideport, Conn., as director of the Copper Division of the Business and Defense Services Administration, U. S. Department of Commerce, has been announced. Merrill succeeds **Jack Howard Smith** who is returning to his job as East Central district sales manager of the Wolverine tube division, Calumet & Hecla, Inc.

On June 15 **Felix E. Wormser** left his post as assistant Secretary of the Interior for Mineral Resources. President Eisenhower announced that he had accepted Wormser's resignation with regret. The President said he (Wormser) could "well be proud of the important public service he had rendered during the past four years."

Following Wormser's resignation, St. Joseph Lead Co. announced that he had rejoined the company as vice-president, the position he held before joining the government on May 1, 1953.

Hendrik F. van der Laan has been elected to the newly created post of president of Vitro Rare Metals Co., a division of Vitro Corp. of America. Van der Laan, who has 21 years experience in the field of extractive metallurgy, was formerly vice-president and general manager of the Tin Processing Corp., an affiliate of the Billiton Co., which designed, built and operated the government-owned tin smelter at Texas City, Tex.

Ernest R. Dondorf, manager of metal purchases, National Lead Co., retired from company service on May 31. He completed 50 years with National Lead on October 5 of last year. Dondorf had been manager of metal purchases since 1939.

Robert P. Rice has joined American Potash & Chemical Corp. as chief control chemist at the company's Henderson, Nev., plant.

N. T. Camicia, general manager of mines for Island Creek Coal Co., has been elected vice-president and general manager of operations.

Following his promotion, Camicia announced a streamlining of the several engineering departments of Island Creek. **W. F. Diamond** will head the consolidated Engineering Department as manager of engineering with

N. T. Camicia

W. F. Diamond

S. M. Dameron as assistant. The formerly separate departments of maintenance, under S. M. Dameron, and construction, under **R. Garrett**, were unified by the move and integrated with the Engineering Department.

Diamond will serve as top engineering executive of the Operating Department of the company, reporting to Camicia. Dameron will supervise activities within the Engineering Department, coordinating its several sections with the line function of the company. Garrett, who formerly headed the Construction Department, becomes superintendent of the Maintenance and Construction Engineering section.

L. D. Ellison heads the Mining Engineering Section of the new Department as chief mining engineer. **L. Y. James**, chief design engineer, heads the Design Section. **John Dunn** will head the Electrical Department as chief electrical engineer.

Earl Boggs continues as chief project engineer; **Ray Taliaferro** continues to serve as assistant chief mining engineer, and **R. D. Herron** will assist the superintendent of Maintenance and Construction Engineering.

Warren L. Howes has resigned as manager of the Western-Knapp Engineering Co., San Francisco, to set up a consulting practice at 1305 Hillview Dr., Menlo Park, Calif.

Thomas M. Ware, administrative vice-president of International Minerals and Chemical Corp., has been elected a director of the company. He fills the vacancy created by the retirement of **David M. Milton,** who served on the board for the past 15 years.

T. M. Ware

The board also elected **Dr. Milton LeBaron,** vice-president in charge of research; **William Bellano,** vice-president in charge of engineering and **Anthony E. Cascino,** vice-president in charge of marketing.

Dr. M. LeBaron

Wm. Bellano

Ware joined IMC 10 years ago as an industrial engineer. He became chief engineer, then vice-president of the Engineering Division before he was named head of the Administrative Division.

LeBaron, who joined IMC in 1942 and directed its research laboratory from 1950 until 1954, when he was named Director of Research, will be in charge of the corporation's entire research and development program.

Bellano joined IMC in 1953 as chief mining engineer of the Engineering Division. He later became the division's general engineering manager and production manager of the Phosphate Chemicals Division. For the past year he has been director of mining and exploration.

Cascino came to IMC as director of marketing in 1956.

Clinton H. Crane, 84-year-old board chairman of St. Joseph Lead Co., has retired.

Crawford L. Wilson, safety director of the New River and Pocahontas Consolidated Coal Co., has been appointed chief of the West Virginia Department of Mines, succeeding **Julius C. Olzer.** Olzer will become director of safety and training of the Hanna Coal Company's New Ireland Mine at Cresap, W. Va.

Michigan Chemical Corp. has announced that **Judson H. Whitman** has been appointed to the position of mining engineer in the company's Rare Earths and Thorium Division. Whitman, who will have charge of exploration and mining programs of Michigan Chemical Corp., pertaining particularly to rare earths, will have his headquarters at Golden, Colo.

Irwin F. Eckhardt recently was named manager of coal mining for the American Gas & Electric Service Corp. Eckhardt had been superintendent of the Morris Creek mine of the Central Appalachian Coal Co. **R. E. McLaughlin,** former resident engineer at Morris Creek, succeeded Eckhardt as superintendent.

The board of directors of the Anaconda Co. have elected **C. Jay Parkinson** to the board. He was also elected a director of the following Anaconda subsidiaries: Andes Copper Mining Co.; Chile Exploration Co., and Chile Copper Co. Parkinson was appointed general counsel of the Anaconda Co. earlier this year. He is also a vice-president and director of the Anaconda Aluminum Co.

In a later move **Mord Lewis** was elected executive vice-president and director of the Anaconda Aluminum Co. Lewis has been associated with Anaconda since 1926 and has been a vice-president of Anaconda Aluminum since 1956.

Walter A. Morris, vice-president in charge of sales of the Dawson-Daylight-Collieries Companies, has been elected executive vice-president of the companies, a newly created position. The company group is composed of Dawson Coal Co., Dawson-Daylight Coal Co., Dawson Collieries, Dawson Coal Sales Co. and Daylight-Collieries Stores.

Howard G. Schoenike, economic geologist of Houston, Tex., has announced his resignation as production geologist for the Baroid Division of the National Lead Co. in order to devote full time to domestic and foreign consultation as a mining geologist. His headquarters will be at 4039 Turnberry Circle, Houston.

Dr. James B. Austin has been appointed vice-president—research and technology of United States Steel Corp.

Ray L. Schultze, formerly mine superintendent of Hidden Splendor Mine Corp., at the firm's Delta mine near Green River, Wyo., and assistant superintendent of the Far West mine at Moab, Utah, has been named general superintendent of Rio De Oro Uranium Mines, Inc., of Albuquerque.

— *Obituaries* —

Lawrence Fox, 75, president and director of the old Park Utah Consolidated Mining Co., died May 21 in Salt Lake City of leukemia.

Walter C. Mendenhall, 86, former director of the U. S. Geological Survey, died June 2 in Chevy Chase, Md., following a long illness.

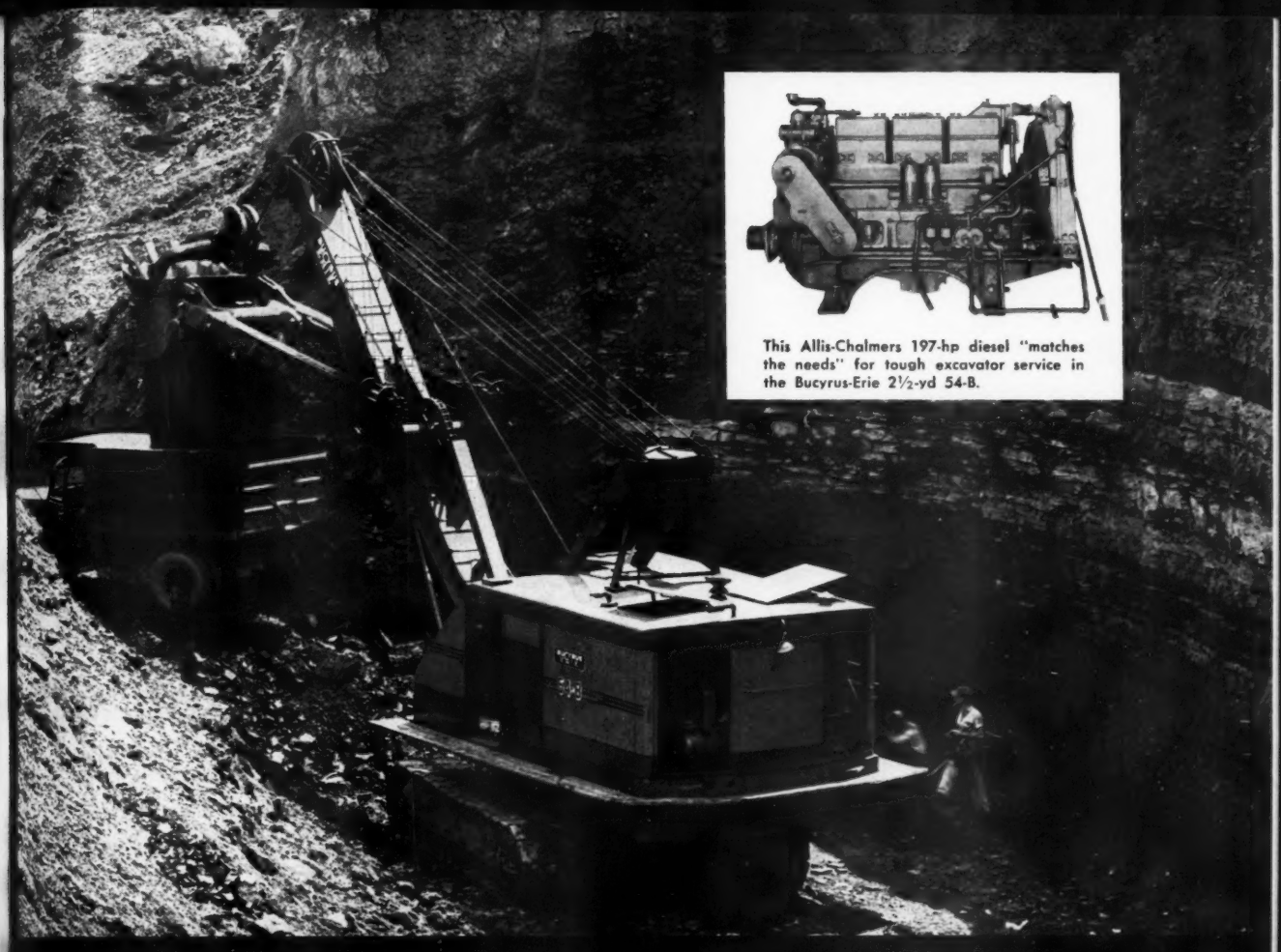
Mr. Mendenhall retired in 1943 after serving 48 years with the Geological Survey. He had been appointed director in 1931.

Richard F. Grant, 77, died May 26 in Gaylord, Mich.

From 1909 until his retirement a few years ago, Mr. Grant was connected with the M. A. Hanna Co. as general counsel, vice-president and later as director. After joining the Hanna organization in 1909 he became a partner in 1917 and a vice-president in 1923. In 1928 he resigned as a Hanna vice-president to become president of the Lehigh Valley Coal Corp., a post he held until 1933. Until a few years ago he continued to hold a Hanna directorship.

Charles H. J. Patterson, 60, vice-president and director of engineering for The McNally Pittsburg Mfg. Corp., died May 25, apparently from a bad heart condition.

During his early mining career, Mr. Patterson worked in Welch, W. Va., as a consulting engineer and as a teacher. For some time he was resident engineer for the Henry Ford Coal Mines in Welch and was later chief engineer for the American Coal Cleaning Corp. He joined McNally Pittsburg in 1930. He achieved international prominence as an expert on coal preparation and traveled extensively throughout the world investigating coal preparation problems.



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This simple question made us realize that while we had a Payroll Savings Plan available we had not promoted it lately among our employees.

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Your State Director, Savings Bond Division, U. S. Treasury Department, will be glad to help you install The Payroll Savings Plan, or build participation in an existing plan. Write: Savings Bonds Division, U. S. Treasury Department, Washington 25, D. C.

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MINING CONGRESS JOURNAL

NEWS and VIEWS

Eastern and Central states

Westmoreland Opens Coal Mine

The opening of a new mine in Boone County, W. Va., was announced recently by the Westmoreland Coal Co. Company officials expect that the new mine will be in full production in about two years.

Involved in the opening of the mine is the laying of 25,000 ft of railroad track through mountain cuts, sinking a shaft to the seam, construction of a preparation plant and installing conveyor belts and four continuous mining machines.

A company official predicted that the shaft will be completed within 8 or 10 months and that some coal will be brought out by next spring.

Medals Awarded Mine Workers

The Joseph A. Holmes Safety Association recently announced the awarding of medals to 18 men for heroic action involving the lives of fellow employes in the mineral industry.

Winners of the medals were: Leonard L. Romesberg, Rockwood, Pa.; Eldridge R. Hanning, Oak Grove, Ohio; Thomas Riley, Jr., Nelsonville, Ohio; William Stephenson, Glouster, Ohio; John Sroka, Colonia, N. J.; Melvin J. Marshall, Huntington, Utah; James I. Olson, Wellington, Utah; Allen R. Cox, Hiawatha, Utah; Ross J. Anderson, Castle Dale, Utah; Roy D. Killen, Henlawson, W. Va.; Earl C. Emerson, Tioga, N. Dak.; Joseph O. Montoya, Grand Valley, Colo.; David M. Pembridge, Rifle, Colo., and Richard C. Yarnell, Ralph McMurtrie, Joseph Furfaro, Wilford Cassidy, and Richard Davis, all of Bellefonte, Pa.

The association voted a special group medal and citation to miners at a Utah coal mine for their work in saving three men trapped by a cave-in. The Association also awarded 522 Certificates of Honor for exceptional safety records and outstanding success in safe supervision.

Osborne Installs Washer

The Osborne Mining Corp. announced recently the installation of a coal washer at the company tipple at Goody, Ky. The new washer is of a dual gravity, heavy media type. It will work in conjunction with the present tipple and bucket line to the Norfolk and Western coal wharf.

New Institute Formed

Pergamon Institute, a nonprofit-making foundation, has recently been formed in New York, and is in course of formation in London, for the purpose of making available to English-speaking scientists, doctors and engineers from all countries that are members of the United Nations, the results of scientific, technological and medical research and development in the Soviet Union and other countries in the Soviet orbit. Over a hundred scientists from many countries have given their support and will supervise the affairs of the Institute.

South Carolina Promotes Minerals

The State Development Board of South Carolina recently announced the hiring of a geologist to make a complete study of the mineral resources of the state.

The board has a long-range program in mind which would include a search for kaolin, clay, limestone, marl and granite deposits.

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Drilling Symposium

The Seventh Annual Exploration Drilling Symposium of the University of Minnesota is to be held at the Center for Continuation Study in Minneapolis on October 3-5, 1957. The five sessions and the discussion period will cover:

Geophysical Instrumentation of Small Bore Holes.

Small Bore Hole Surveying.

Reliability and Weighing of Drill Hole Analyses.

Diamonds and Synthetics for Drill Bits.

Air and Mud Drilling.

Personnel Training and Drill Standardization.

Applications for registration may be obtained by writing to the Center for Continuation Study, University of Minnesota, Minneapolis, Minn.

West Kentucky Plans Two Mines

Development of two new coal mines will be started soon by the West Kentucky Coal Co. it was announced recently by Cyrus S. Eaton, chairman of the company. Both mines are expected to have production capacities of around 1,750,000 tons annually.

Although the specific sites of the mines was not announced the company estimates that the development of the two mines would cost more than $13,000,000 and production would begin late in 1958 or early 1959.

Olin Mathieson Expands

The Olin Mathieson Corp. announced recently the expansion of its overseas activities including the production and marketing of non-ferrous metals and other products. The new firm will be known as the Olin Mathieson International Corporation.

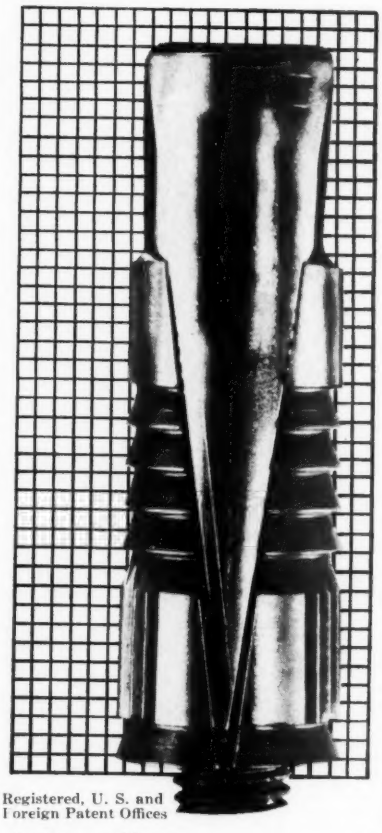
Named as president, of the wholly owned subsidiary, was Stanley de J. Osborne who was formerly vice-president of Olin Mathieson in charge of its South American operations.

Danes Plan Greenland Uranium Search

A team of over 40 geologists and chemists will be sent to Greenland this summer by the Danish government to explore the mineral wealth of the area especially uranium, it was reported recently from Copenhagen.

A preliminary study of the area around Marssaq on the Skov Fjord shows a fairly high uranium concentration which may be worth exploitation. Serious prospecting for uranium began only two years ago, although the existence of uranium in east Greenland was reported as early as 1948.

In addition to uranium, the exploration group will study known deposits of gold, silver, nickel, lead, graphite, marble, coal, oil and iron.



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SOLVENT EXTRACTION

(*Continued from page* 55)

tively stripped at 1/10 ratio to produce solutions suitable for electrolytic recovery of the individual metals. Simultaneous regeneration of the strip solutions during electrolysis with five percent strip make-up is assumed. The costs are calculated on a per-pound-combined-metal basis. This estimate indicates a plant investment of $497,000 and an operating cost of $0.061 per pound of metal. Such a cost for this operation is certainly economically attractive and indicates that solvent extraction should receive major emphasis in approaches to this separation problem.

Zinc Electrolytic Purification, Case VI

Solvent extraction can also be considered for the removal of undesirable impurities from metallurgical solutions. For example, the removal of cadmium from electrolytic solution. Assume a 25-gpm stream containing 100 g/l zinc and 0.2 g/l cadmium to be treated by solvent extraction to remove the cadmium with both extraction and strip feed ratios of 1/10 and cadmium to be precipitated from the strip solution by an operation whose complexity is X=2. The plant investment, in Table II, is estimated at $171,000 with an operating cost of $7.48 per pound of cadmium! Although this is only $0.015 per pound of zinc purified, this cost is probably prohibitive. The itemized estimate indicates that on this small concentration the relatively large plant makes costs related to labor and plant impractically large.

Conclusion

Research and development on solvent extraction is justified in many instances. Solvent extraction will be more frequently encountered with the trend toward hydrometallurgical processing, of which solvent extraction is a part. The information and estimates presented indicate that solvent extraction, like any other new operation, is not a panacea for metallurgical problems, but simply another tool to be added to the metallurgist's "kit." Solvent extraction will be applied in metallurgical operations where its unusual characteristics show promise of overcoming metallurgical problems.

Solvent Extraction will become a major metallurgical operation within the next five to ten years. It is a "natural" for the exotic metals—those that are costly and difficult to treat. It will see utility even in the base metals. In particular, solvent extraction will probably be applied to the recovery and separation of copper, cobalt, and nickel, and to the recovery of copper and zinc.

(Continued from page 73)

would be willing to provide funds for purchase of these other two minerals.

Based on these assertions, the Senate Interior Committee wrote into the Interior Department appropriation bill a provision for $6.7 million to buy fluorspar and asbestos during the next fiscal year. The Senate approved the measure and it is now before the House, where it is expected that similar action will be taken.

It is understood that members of the House and Senate Interior Committees plan to undertake studies of other legislative possibilities to aid the domestic tungsten industry.

New Oil Import Study

ODM Director Gray has conducted an investigation into crude oil imports and is expected to recommend to the President a voluntary program of import restriction. Gray has conferred with representatives of the major oil importing companies and has indicated that he is prepared to certify to the President that oil imports are threatening the national security.

Meanwhile, informed sources state that President Eisenhower will shortly announce the make-up of a Cabinet Committee to conduct a formal investigation of crude-oil imports under provisions of Section 7 of the Trade Agreements Act. Under those provisions the President is authorized to take any action he feels necessary to adjust imports of an article to a level that will not threaten to impair national security. The Cabinet Committee membership is reliably reported to be the same as that which undertook the Energy Supplies and Resources study, and will have a task force or "working group" headed by former Under Secretary of State Herbert Hoover, Jr.

Metal Mine Safety Up Again

During the past month a House Education and Labor subcommittee, headed by Rep. Wier (Dem. Minn.), has held brief hearings on measures which would give the U. S. Bureau of Mines mandatory power to enter and make health and safety inspections of metal and nonmetallic mines and would require that operators of such mines report all accidents involving loss of life or bodily injury to the Bureau.

Representatives of the Bureau of Mines and the Public Health Service reiterated the opposition of their agencies to the bills as voiced last December. Interior Under Secretary Chilson submitted a letter to the Committee in which he pointed out that the pending bills were patterned after the Federal Coal Mine Safety Act, and then went on to emphasize that the accident rates in metal and nonmetallic mines are much lower than in coal mines and that conditions leading to the adoption of the coal mine safety law do not exist to the same degree for metal and nonmetallic mines. He stated that safety inspections in such mines were primarily a matter for the States, and that the Federal Government should continue its educational and safety promotional work as at present.

Further hearings will be held to receive testimony from representatives of mine labor and mine operators. Additional field hearings may also be conducted.

Labor Hearings Continue

Public hearings before the Senate Select Committee on Labor Racketeering continue to reveal shocking practices by labor union leaders. These hearings will run not only through the present session but will be held after the adjournment of Congress. The disclosures of corrupt practices in the unions is expected by most observers to result in legislative recommendations not only to regulate union welfare and pension funds but to regulate union political activities, strengthen the powers of the States in the labor field, and clamp curbs on secondary boycotts and union violence.

Hearings are also continuing before Senate and House Labor Committees on proposals to require Federal registration and disclosure of financial reports on employe pension and welfare funds. Labor Secretary Mitchell has proposed registration of all labor and management operated welfare and pension funds with the Labor Department and full disclosure as to these funds. Measures pending before the committees are similar, but some of them would exempt from the registration requirements plans covering fewer than 25 employes. A long string of witnesses from management, labor, insurance and banking interests, and State officials is testifying. Testimony ranges from advocacy of the bills to amending them to exempt banks and management plans. Opposition to any registration requirement was voiced by UMWA president John L. Lewis.

Newmont Consolidates Labs

Newmont Exploration Ltd., a subsidiary of Newmont Mining Corp., has recently established a Geophysical and Metallurgical Research Laboratory near Danbury, Conn. This Laboratory combines the two laboratories previously situated at Jerome, Ariz., and Grass Valley, Calif.

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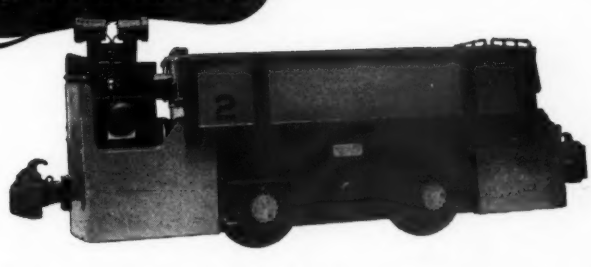

The Greensburg 8 ton Monitor is equipped with two glass insulated motors, contactor type controller and double equalizers. These double equalizers make the difference in performance . . . more tractive effort, better brakes, better riding qualities and longer battery life than any other storage battery locomotive of equal weight and battery capacity!

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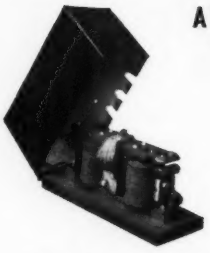

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For gaseous mines. Inverse time limit element permits maximum motor performance with positive protection. In event of overload it is only necessary to move handle to "reset" position, no fuse to change.

FUSED ALL-PURPOSE SWITCH
70 to 400 amp

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Island Creek Expands Fleet

Island Creek Fuel & Transportation Co. announced recently that a contract had been let with the Dravo Corp. for the construction of a second twin-screw 148-ft diesel towboat. It will be a sister ship to the **Raymond E. Salvati** which was launched last summer.

The new craft will be powered by two Enterprise engines with a combined 2560 shaft hp and will be used in the Ohio River coal trade. The all-welded steel craft will include such modern features as radar, ship-to-shore telephone, Kort nozzles, hydraulic steering system for the six rudders, reverse-reduction gears and metal-paneled interior walls. Officers and crew will be quartered in nine staterooms.

Kennecott in Arctic Hunt

The Kennecott Copper Corp. and the Hudson's Bay Co., have entered into an agreement to explore for base metals in the Canadian Arctic, according to a recent announcement made at the annual meeting of the Hudson's Bay Co.

Hudson's Bay has a 20 percent interest in the venture and Kennecott has the remaining 80 percent. They have an exclusive mineral concession in a region west of Hudson Bay covering an area of 620 square miles. Copper mineralization has been discovered in the area.

Ore Boat Keel Laid

The keel was laid recently for a 710-ft coal and ore carrier at the Toledo works of the American Shipbuilding Co. The ship is being built for the Interlake Steamship Co. of Cleveland and is the largest such ship to be built in Toledo.

The ship, which will cost $7,000,000, is due for completion by April 1, 1958, and will join Interlake Steamship's fleet of 32 lake carriers. It will be powered by an 8500-hp steam turbine.

The dock in which the 710-ft vessel is being built is only 660 ft long. All but the 50-ft bow will be built in the drydock and then the ship will be floated and the stern will be flooded to tip up the forward end so the bow can be welded into place.

Coal Research Funds Granted

Four research projects devoted to new uses for coal were authorized recently by the Pennsylvania State Coal Research Board. The project will cost $447,000 with Penn State University's College of Mineral Industries receiving the largest contract, for $348,700.

The other contracts are with the Anthracite Institute of Wilkes-Barre which will receive $17,500, Bituminous Coal Research, Inc. of Pittsburgh, $60,000, and Carnegie Institute of Technology of Pittsburgh, $20,000.

The programs range from developing cheaper ways to crush anthracite into small sizes to achieving an easy method to remove sulphur from coking coal.

Hanna to Reopen Mine

Announcement was made recently by the M. A. Hanna Co. of plans to bring back into production the Moose Mountain iron mine near Capreol, Ont., Canada. The mine was closed about 38 years ago when its high-grade ore was exhausted.

In addition to reopening the mine, the Hanna Co. plans to construct a new mill and a new subdivision to the city of Capreol for workers. A spur line is being built from the C.N.R. right-of-way to service the mine.

Plan Large Ohio Coal Mine

North American Coal Co. has announced plans to build a $10,000,000 coal mine in Monroe County, Ohio. The company reports that demands by expanding Ohio Valley industries led to the acquiring of 17,000 acres of virgin coal land.

Scholarship Winners

Five young men and women have been selected for awards of college scholarships by the Princess Elkhorn Coal Co. of David, Ky., according to a recent announcement from the company. The award winners this year bring to 55 the number of grants made to graduating seniors in Floyd and Johnson Counties in Kentucky.

Presentation of awards were made by Raymond A. Bradbury, scholarship chairman for Princess Elkhorn.

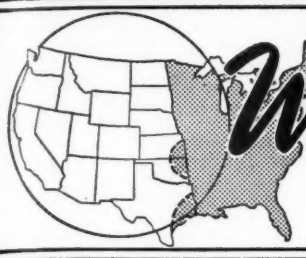
C&O Plans Coal Pier

A new $7,000,000 coal pier will be built at Toledo by the Chesapeake and Ohio Railroad according to a recent announcement by vice-president M. I. Dunn. The new pier is scheduled for completion in June of next year.

It is expected that the new pier will expand C&O's coal loading facilities at Toledo by 40 percent. It was also announced that the C&O's new $8,000,000 pier at Newport News, Va., will be put into operation this summer.

Docks Facilities Expanded

The Powhatan Mining Co. of Powhatan Point, Ohio, announced recently plans to expand its coal loading dock facilities on the Ohio River. The plans call for doubling the length of the existing 700-ft dock and the construction of a new 350-ft dock. The work will be done by the Dravo Corp.



Western States

American Zinc Curbs Zinc Output

The second curtailment of zinc output by American Zinc, Lead & Smelting Co. within two months was announced recently by Howard I. Young, president. The most recent curtailments were at Fort Smith, Ark., where production was cut back 40 percent and at Dumas, Tex., where production was curtailed by 10 percent.

The company, on June 1, shut down mining operations at its Nellie B mine at Picher, Okla., which had been producing at an annual rate of 11,000 tons of zinc concentrates and 1400 tons of lead concentrates.

The announcement said, "it is believed by management that metal output should be curtailed until there is either a reduction in imports of foreign refined zinc into this country or a substantial increase in demand from domestic consumers."

Huge Uranium Mill Planned

The U. S. Atomic Energy Commission and Kermac Nuclear Fuels Corp., Oklahoma City, have signed a contract which will result in the construction and operation by Kermac of a uranium processing mill of a rated capacity of 3300 tons of ore daily. The mill, scheduled for completion next year will be built at a cost of about $16,000,000, about 25 miles north of Bluewater, McKinley county, N.M., to handle Ambrosia Lake ores owned or controlled by Kermac as well as ore produced by independent operators in the area.

The largest uranium mill now in operation is the 3000 tpd Anaconda mill at Grants, N.M.

Gilsonite Pipeline Begins Operation

American Gilsonite Co. has placed in operation its 72-mile, $2,000,000 pipeline for the transportation of a solid hydrocarbon slurry from mines at Bonanza, Utah, to the company's new refinery at Gilsonite, Colo., near Grand Junction. The pipeline carries a mixture of crushed Gilsonite ore and water which will be converted into high-grade metallurgical coke and gasoline at the new refinery.

For virtually all of its length the pipeline crosses uninhabited country over some of the most rugged terrain in the west. It spans two canyons via suspension bridges and crosses an 8500-ft mountain pass.

The 6-in. pipeline will transport 700 tpd of Gilsonite ore.

Lucky Friday Development Plan Announced

Lucky Friday Silver-Lead Mine Co. is planning development of two new deeper levels at its property east of Mullan, Idaho, in the Coeur d'Alene district. Sinking of the main shaft to the 3130 level has been completed and ventilation facilities are now being installed in preparation for starting crosscuts to the ore body on both the 2450 and 3050 levels.

The 2450 heading is expected to reach the vein about 260 ft south of the shaft; on the 3050 level about 475 ft of crosscutting will be necessary to reach the projected position of the structure because of its southerly dip.

Other development plans include extension of the east drift on the 2150 level, where a five-ft width of good ore is exposed in the face, extension of the west drift on the 2300 level in the Gold Hunter area leased from Day Mines, Inc., and a west drift on the 1600 level where a good ore showing is exposed.

Operations are being planned with a view to completing exploration and stoping work on upper levels so that maintenance of these workings can be eliminated.

Titanium Plant Expansion

The $15,000,000 expansion program of Titanium Metals Corp. at Henderson, Nev., is proceeding rapidly and the Melt Shop, which will be used for melting titanium sponge into ingots, is expected to be ready for operation by August 1 of this year.

The building is 70 ft high and has a work area of 51,000 sq ft — the largest building ever erected solely for melting titanium, it is believed.

National Lead Co. and Allegheny Ludlum Steel Corp., TMCA's parent companies, announced in August 1956 that the Henderson plant would be producing 30 tons of titanium ingots per day by the end of 1957.

Arizona Manganese Test Results Announced

Results obtained by the U. S. Bureau of Mines metallurgists during extensive pilot plant tests of processes for recovering manganese from low-grade Arizona ore are discussed in a technical report released by the U. S. Department of the Interior. The publication is second in a series telling of the bureau's work on ore from the Maggie Canyon deposit in the Artillery Mountains region of Mohave County. A copy of Report of Investigations 5330 "Pilot Plant Flotation of Manganese Ore," can be obtained from the Bureau of Mines, Publications-Distribution Section, 4800 Forbes Street, Pittsburgh 13, Pa.

Plans Montana Copper Exploration

The Anaconda Co. is planning to conduct an extensive prospecting and development program on a recent copper ore discovery in the Sweetgrass Hills, near Shelby, Mont. Present plans are to use bulldozers in removing the thick mantle of slide rock over the ore; extent of development work will depend upon discoveries made this year.

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BELT FASTENER No. 500

For Heavy Conveyor Belts of changing length

These heavy-duty belt fasteners make a strong, flexible joint in conveyor belts, belts of any width and of from 3/8" to 1/2" thickness. They offer special advantages in mines, quarries or industrial setups where length or position of belt is frequently changed, because sections can be removed or added at will. Joints are opened for this purpose by simply pulling out the hinge pin. Easily and quickly applied on the job or in the shop. Special design gives deep compression into belting and smooth, flush joint.

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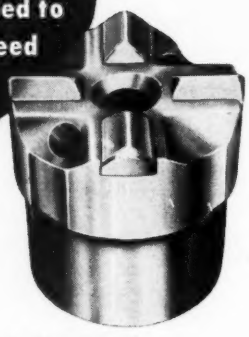

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TEE CEE BIT

Liddicoat — pioneer in the development and manufacture of the single-use steel bit — now after years of experience and research, has developed a tungsten carbide-insert bit that completely revolutionizes drilling with carbide bits.

The new Liddicoat TEE CEE bit (Patents applied for) is "drilled to destruction without the necessity of resharpening." Even when dulled, a reverse taper does not occur. In the conventional multi-use carbide bit, a reverse taper stops drilling. The four-point bit permits fast collaring, fast cutting, and easy removal from the hole. New lower first cost and lower cost per foot of hole drilled.

TAPER SOCKET . . . NO THREADS FIRM, FAST ATTACHMENT

Illustrated is the improved taper with shim, perfected to provide ease of attachment and removal. No threads to strip; longer rod life.

WESTERN
Rock Bit Manufacturing Company
552 West 7th South • Salt Lake City 1 Utah

Mine Maintenance Engineer

U. S. company mining in Haiti has excellent opportunity for operating engineer experienced in electrical and mechanical maintenance and repair. Require electrical background in generation, distribution and controls; also maintenance and repair experience in drying plant and open pit mining equipment. Engineering degree not essential, but 7-10 years experience required. Give complete details on age, education, and experience in above fields, and salary required. Box 757.

Idaho Uranium Search

Uranium Mines, Inc., of Wallace, Idaho, has concluded an agreement with Pinnacle Exploration, Inc., of New York, exploration subsidiary of Callahan Zinc-Lead Co. and Vulcan Silver-Lead Corp., for exploration and development of Uranium Mines' extensive holdings in the east end of north Idaho's Coeur d'Alene district. Preliminary exploration work has already gotten under way.

Terms of the agreement provide that Pinnacle shall advance all funds for the program and shall be entitled to recover its investment in full out of profits from any production from the property. Subsequent profits would be divided equally between Pinnacle and Uranium Mines.

Property to be explored under the agreement consists of approximately 200 mining claims and embraces an area approximately two miles in width and six miles in length, all of which is located north of the Osburn fault.

First East Slope A-Ore Processing Mill

The Atomic Energy Commission has signed a contract with the Cotter Corp. of Santa Fe, N. M., to build Colorado's first eastern slope uranium ore processing mill at Canon City. The mill will be a pilot operation designed to test a new milling process and will have a capacity of 50 to 100 tons of ore per day. The Colorado School of Mines Research Foundation at Golden will cooperate with Cotter on the project. The company expects to have the mill in operation by December 1.

Kennecott Plans Refinery

A second electrolytic refinery for copper will be built by the Kennecott Copper Corp. at an estimated cost of $20,000,000 it was announced recently by company officials. The site of the new refinery has not been determined.

As planned the new plant will have an initial capacity of 7000 tons a month and is scheduled to be in operation by mid-1959. Company officials said the decision was made to build the new plant to meet increased demand for this type of copper in preference to fire-refined metal.

New Calcining Plant in Arkansas

Announcement was made recently of plans by the American Cyanamid Co. to install new calcining facilities at Bauxite, Ark. It is expected that the new facilities will be completed the latter part of this year.

The calciner will treat bauxite ore from the company's Quapaw deposit. In addition to the calciner the company also plans to build office and laboratory buildings.

The company's mine and calcination plant are located about 20 miles south of Little Rock and will be managed by R. H. Harris. Cyanamid's other bauxite mines are located in Adairsville, Ga., and Berger, Ark.

American Metal Gets Lithium Property

American Metal Co., Ltd. recently obtained a 60 percent interest in lithium property at Bernice Lake, Manitoba, Canada, after reaching an agreement with Montgary Exploration, Ltd. of Canada.

Diamond drilling has indicated the presence of 7,887,218 tons of ore in the area averaging 1.87 percent lithium. American Metal will advance $1,800,000 to a jointly owned company to bring the properties into production. American Metal may also build a 1000 to 1500 ton-a-day concentrator.

Homestake Goes Deeper

The interior winze shaft of Homestake Mining Company's Gold mine at Lead, S. D., has been sunk to 5705 ft and drifts are being advanced along ore zones on the 5300 and 5600-ft levels, stockholders were told at the firm's annual meeting in San Francisco.

Fire Destroys Morning Mill

One of the Coeur d'Alene, Idaho, mining district's most famous landmarks, the American Smelting and Refining Company's old Morning mill at Mullan, has been destroyed by fire with damage estimated at between $400,000 and $500,000. Cause of the blaze was believed to be an explosion in the mill substation. The fire burned fiercely for several hours, reducing to twisted wreckage the valuable mill machinery. Only a favorable wind and heavy rains of previous days kept the blaze from spreading to timber on the hillside above the mill and starting what could have been a serious forest fire.

The flames consumed the entire mill, the laboratory and sample house and other associated buildings, including an old "dry" which was no longer being used. A "dry" in the mill building, which was being used by the mine crew was destroyed.

The first unit of the Morning mill was built shortly before the turn of the century as a replacement for a previous plant which had burned in 1898. It was gradually expanded, improved and modernized to one of the largest concentrator plants in the district.

The Morning mine is one of the oldest in the district and gained considerable renown as the world's deepest lead mine. At one time the operation employed nearly 1000 men, but at the time of the fire the crew totaled only 180 men, including mine, mill and surface employes.

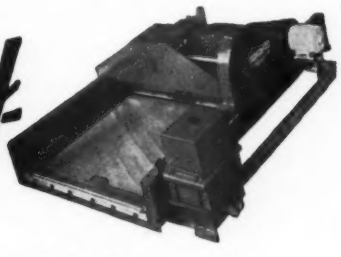
WANTED

Mining Congress Journal offers excellent opportunity for mining engineer with experience in nonferrous metal mining. Position involves writing and working with members in the mining industry.

Address inquiries to the editor. Include information on age, education, experience, marital status and a recent photograph.

THE Leahy HEAVY DUTY

No Blind Vibrating Screen

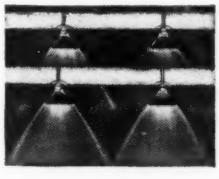


Unexcelled for Fine Mesh Screening

For fast, efficient screening of materials in the fine mesh range, the Leahy® No-Blind® Vibrating Screen is unique in its field.

Employing an exclusive differential vibration that snaps wedging particles loose 1600 times per minute, the screen may be operated on long, continuous schedules at top capacity.

Where damp or sticky materials are encountered, FlexElex® electric heating (not an attachment) is fully factory-integrated for maximum electrical and thermal efficiency. Send for Bulletin 16-EH.



CONCENCO® Spray Nozzles

These handy nozzles are simple, flexible and economical. All you do is drill one oversize hole per nozzle, clamp on and get results. They can be definitely aligned for washing, sluicing or spraying according to need. They are removed or replaced in a moment's time.

THE DEISTER★ CONCENTRATOR COMPANY

CONCENCO PRODUCTS

★ *The ORIGINAL Deister Company* ★ *Inc. 1906*

917 Glasgow Ave. • Fort Wayne, Ind., U.S.A.

Standing, left to right: C. F. Beukema, John Bley, N. Weiss, Karl W. Jasper, J. Stanley Mitchell, O. Glaeser, J. C. Kieffer, H. C. Weed, F. V. Richard, Kuno Doerr, Jr., J. C. Landenberger. Sitting, left to right: J. B. Cummings, R. L. Moran, Ray Holbrook, L. F. Pett, Miles P. Romney, Earl S. Mollara, A. Q. Lundquist, Rayce R. Hardy, Jack How, Clark Wilson, J. E. M. Wilson, J. D. Conover, A. H. Shoemaker, R. W. Van Evera, Blair Stewart

1957 METAL MINING AND INDUSTRIAL MINERALS CONVENTION

National Program Committee Formulates Plans for Salt Lake City

This year's most important "hard-rock" mining meeting will be held September 9-11 in Salt Lake City. A large number of pressing matters will be thoroughly aired at the 18 sessions that have been scheduled on the Convention program. The program will be studded with timely, straight-from-the-shoulder discussions by able mining men, leading industrialists and top Government officials.

Full attention will be given to national minerals policies . . . labor relations and management problems . . . the outlook for the mineral industries . . . safety and health . . . gold, silver and monetary problems . . . and special questions relating to industrial minerals, uranium, the strategic minerals industries, etc.

The many aspects of ore production and mine operation will be covered at sessions devoted to underground drilling progress, roof support, shaft sinking, and new developments in mechanized mining . . . rotary drilling and new blasting practices for open pits, loading, transportation, and engineering aspects of pit design . . . exploration trends and new methods of ore detection . . . and a wide range of problems in mineral dressing and metallurgical research. A special conference has been arranged for the discussion of problems concerning industrial engineering and modern management techniques.

The future of uranium will be fully discussed, with attention focused on new mining developments and the world outlook for nuclear applications.

The Welcoming Luncheon on Monday noon, September 9, featuring an interesting and timely address by a prominent national figure, will be followed by a series of evening events which contribute greatly to the gayety and good-fellowship of the convention.

The Miners Jamboree on the opening night will be held at the world-famous Saltair amusement park—with a refreshment hour, steak dinner, dancing and a top-flight floor show. On Tuesday, Kennecott's Utah Copper Division will be host for refreshments and supper on the 6190 level of the immense open pit mine at Bingham Canyon.

Climaxing convention week will be the Annual Banquet at the Rainbow Randevu. It will be a "speechless," informal event with a fine dinner, brief introductions of honor guests, excellent music, and a real treat in the way of entertainment.

The ladies are invited to all convention functions, and will also have a special program of their own. On Tuesday there will be a Luncheon and Fashion Show at the beautiful new Union Building of the University of Utah; and a Brunch at the Fort Douglas Club and the Salt Lake Country Club on Wednesday will be followed by a special Organ Recital at the famous Mormon Tabernacle.

Advance registration cards and hotel accommodation requests should be sent in as soon as possible. While hotel space in Salt Lake City is limited, other excellent accommodations available include a large number of modern air-conditioned motels, many of them located in the downtown area.

Sunshine Opens New Ore

Two development headings on the bottom 4000-ft level at the silver mine of Sunshine Mining Co. west of Wallace, Idaho, have opened the downward extension of important ore bodies. A north crosscut from the main Jewell shaft broke into the Silver Syndicate fault-vein in the West Rambo area and exposed good-grade silver-lead ore, the company announced. The ore is about one foot wide at the point of intersection; drift-work to expose the ore zone along its strike is now underway.

In the easterly workings of the mine, another drift has reached the downward projection of the main Chester ore shoot on the 4000 level in the Rotbart area after about 75 ft of advance. Further development work will be necessary to determine the quality and the extent of the ore on this lower horizon.

Wanted

Graduate engineers with a minimum of four years' experience in design, construction, or operation of ore beneficiation or hydrometallurgical plants. Duties involve administration of mill contracts throughout Western United States. Annual salary range $7035 to $10,065 dependent upon qualifications and experience. Submit resume of education, experience, and personal history to Personnel Office, U. S. Atomic Energy Commission, Grand Junction Operations Office, Grand Junction, Colo.

California Cement Plant Opened

Permanente Cement Co. has officially opened its new $13,000,000 plant near Lucerne Valley, Calif. The plant, with a capacity of 2,500,000 bbl of cement a year, marks Permanente's first major entry into southern California. It raises the company's capacity to 11,000,000 bbl of cement annually and its share of the total market in the Pacific Coast States and British Columbia to 20 percent.

Chief Consolidated Shuts Down

Chief Consolidated Mining Co., last operating metal mine in Utah's historic Eureka-Tintic district, has suspended operations indefinitely. Some 70 miners and their families are affected by the closure of Chief Con, a lead-zinc producer since 1909.

Low prevailing prices resulting from imports of lead and zinc were cited as the reason for the shutdown.

In the largest underground mine in the United States, over 70% of the daily production of 28,000 tons of molybdenum ores—more than half of all the moly this side of the iron curtain—is hauled in Card Granby type cars built to Climax specifications.

These are the largest and heaviest cars of this type we have built . . . designed to withstand unusually rugged loading conditions plus the wear and tear inflicted by a cleanout machine (also a Card product).

CARD car engineering results in large savings to many of the major ore producers of the world with cars built to special order at little more than the cost of standard stock models. CARD engineers are happy to consult on any haulage problem. No obligation.

C.S. Card Iron Works Co.
2501 WEST 16th AVE.
DENVER, COLORADO

Twelve U-Mills Operating

Twelve uranium processing mills are in operation in the United States and ten more have received AEC approval and are under construction. With the exception of a mill at Monticello, Utah, the mills are privately owned.

The mills currently in operation, the operating company and location are: Union Carbide Nuclear Co., Uravan, Colo.; Vanadium Corp. of America, Durango, Colo., and Naturita, Colo.; Climax Uranium Co., Grand Junction, Colo.; Kerr-McGee Oil Industries, Shiprock, N. M.; Anaconda Co., Grants, N. M.; Vitro Uranium Co., Salt Lake City, Utah; a Federal mill at Monticello, Utah; Mine Development, Inc., Edgemont, S. D.; Rare Metals Corp. of America, Tuba City, Ariz., and Uranium Reduction, Moab, Utah.

Mills under construction are: Atomic Fuel Extraction Corp., Bedrock, Colo.; Texas-Zinc Minerals Co., Mexican Hat, Utah; Dawn Mining Co., Ford, Wash.; Western Nuclear Corp., Split Rock, Wyo.; Union Carbide Nuclear Co., Rifle, Colo.; Trace Elements Corp., Maybell, Colo.; Gunnison Mining Co., Gunnison, Colo.; Lucky Mc Uranium Corp., Fremont County, Wyo.; Homestake-New Mexico Partners, Grants, N. M.; Homestake-Sapin Partners, Bluewater, N. M., and Kermac Nuclear, Bluewater, N. M.

New Mexico Mine Closes

Peru Mining Co., one of three operating lead-zinc mines in Grant County, N. M., has closed down as a result of dropping zinc prices. Vice-president Joseph Taylor said that his company regretted closing down operations and terminating employment at both the Hanover mine and the concentrator at Deming. Taylor said the shutdown will stay in effect as long as the market price of zinc remains below the production costs.

Total labor force at the mine and mill is 110.

Arizona Copper Project Planned

Duval Sulphur & Potash Co. is planning a $20,000,000 copper and molybdenum mining development 25 miles southwest of Tucson, Ariz., where the company has been doing exploratory work for two years.

The company's ore reserves are estimated at 49,000,000 tons. Construction plans call for a concentrator capable of handling 10,000 tons of ore per day.

Idaho Mine Reopened

Idaho Goldfields, Inc., has resumed operations at its lead-silver-gold property near Fourth of July summit between Kellogg and Coeur d'Alene, Idaho. Mining of lead carbonate ore was scheduled to get underway as soon as the 168-ft inclined shaft had been dewatered.

WANTED

Rare Earth Ores

CONCENTRATES

EUXENITE • FERGUSONITE • GADOLINITE

SAMARSKITE • THORITE • THORTVEITITE

XENOTIME

Tell us what you have. Write:

RARE EARTHS AND THORIUM DIVISION

MICHIGAN CHEMICAL CORPORATION

Saint Louis, Michigan • or P.O. Box 481, Golden, Colorado

Operating Agreement Signed

Radorock Resources, Inc., Salt Lake City, has entered into an agreement whereby it will operate a uranium mine and other properties in the Gas Hills, Wyo., area held by Ran-Rex Oil and Mining Co. Under the terms of the agreement, Radorock will be the operator of the mine and claims and will share profits with Ran-Rex.

Included in the agreement are 24 claims approximately 50 miles east of Riverton, Wyo. An open-pit mine, from which ore has been shipped for more than a year, is being operated on one group of four claims.

Kennecott Awards Scholarships

Six sons and daughters of Kennecott Copper Corp. employes in Utah have received $500 scholarships to any accredited institution of higher learning in Utah. This marks the third consecutive year Utah Copper Division of Kennecott presented the awards to deserving high school seniors who are dependents of employes.

Potash Test Holes Drilled

Delhi-Taylor Oil Corp., Dallas, Tex., has been drilling preliminary shaft pilot test holes in the Seven-Mile Canyon area north of Moab, Utah. The company believes it has large potash reserves and is tentatively planning construction of shafts and a processing mill.

Correction

In the May issue of MINING CONGRESS JOURNAL it was incorrectly reported that the capacity of a newly proposed uranium mill in the Ambrosia Lake area of New Mexico, submitted by Phillips Petroleum Co., would be 150 tons of ore daily. The proposed capacity is 1500 tons of ore per day.

Bauxite Plant in Operation

The first shipment of bauxite ore mined in Haiti by the Reynolds Metals Corp., has been delivered to the company refinery at Corpus Christi, Tex.

This shipment climaxed more than two years of effort by the American company, through its subsidiary, the Reynolds Haitian Mines to develop bauxite deposits. An investment of over $8,000,000 was made by the company in this development.

The mines are located 2000 to 3000 ft above sea level and the bauxite is carried six to 12 miles to the shore where it is stored for shipment.

Survey Publishes Arizona Map

The U. S. Geological Survey has published a new state map of Arizona which is available in two editions. The planimetric base map edition in three colors shows only water and cultural features, but the nine-color, topographic edition shows land forms, forest and recreation areas, Indian reservations, principal drainage features, county and State boundaries and county seats, as well as the more important named geographic features.

A new index to Arizona mapping will soon be available from the Geological Survey upon request.

Chemical Subsidiary Formed

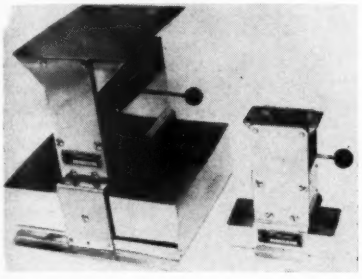
American Potash & Chemical Corp. of Los Angeles, has formed a new subsidiary, San Antonio Chemicals, Inc., for which a $750,000 plant has been constructed at San Antonio, Tex.

The new facility is located adjacent to another American Potash subsidiary, American Lithium Chemicals, Inc. The new company will process end liquors resulting from A.L.C. lithium hydroxide manufacturing processes to produce a mixed alkali salt composed of the metal carbonates of potassium, rubidium, cesium, sodium, and lithium.

Manufacturers Forum

Sample Splitters

FOR SAMPLING OF FINE MATERIALS which segregate easily, Carpco sample splitters are designed with stainless steel splitter blades, held rigidly between machined aluminum alloy blocks. All samplers are provided with top hoppers having a bottom discharge slot and cut-off gate. When the gate is tripped, the sample falls like a curtain over the accurately



spaced stainless blades. Two deep drawn aluminum alloy sample pans with all rounded corners are supplied with each splitter.

Three models are available: (1) Model SS-324 gives a 32 division split with ¼-in. wide chutes; (2) Model SS-168 gives a 16 division split with ½-in. wide chutes; and (3) Model SS-162 gives a 16 division split with ⅛-in. chutes.

Request Bulletin No. SSB-103 from Carpco Manufacturing, Inc., Jacksonville 6, Fla.

Stationary Screen

FOR THE CONTINUOUS WET SCREENING of slurries containing non-fibrous solids, Dorr-Oliver Inc. has announced the availability of the Dorr-Oliver DSM Screen. This screen is said to be particularly adaptable to separations in the 8 to 48 mesh range. Because of unique principles of design both screen capacity and efficiency are far greater than those of vibrating screens, according to the manufacturer.

The screen is available in four standard sizes ranging in width from one to four ft in increments of one ft. Vertical dimensions of all four sizes are identical. Capacity is approximately 200 gpm per ft of width when making a 48 mesh separation and as high as 500 gpm per ft in producing an eight mesh separation. Actual capacity varies, of course, depending upon material handled.

Further information may be obtained from Dorr-Oliver Incorporated, Barry Place, Stamford, Conn.

Fork-Lift Truck

POWER BRAKES, power steering and finger-tip directional control are standard on a newly announced 8000-lb capacity pneumatic tire fork-lift truck. Called the Yardlift 8024, it has four speeds in each direction and will travel 16½ mph forward and 16 mph reverse. Lift speeds are 48 fpm empty and 42 fpm loaded. With a length of 132 in. and width of 77 in., the truck has a turning radius of 134¾ in. Wheelbase is 86 in. For additional data write to Industrial Truck Division, Clark Equipment Co., Battle Creek, Mich.

Inquiries about new equipment appearing in Manufacturers Forum are welcomed. For additional information on any piece of equipment in this section write directly to the manufacturer, or to Mining Congress Journal with name of item and date of issue in which it appeared.

Pillow Blocks

A LINE OF SPHERICAL ROLLER BEARING pillow blocks, called Spher-Align, has been announced by the Dodge Manufacturing Corp., Mishawaka, Ind. A mounting feature, called Micro-Mount, reportedly makes it possible to seat Spher-Align bearings solidly on shafts. This is accomplished through the use of set screws located parallel to the bore in the adapter nut. After the bearing is snugged up with the adapter nut, adjustment is completed by turning the Micro-Mount screws against the locking washer until bearing, adapter and shaft form an integral unit.

These bearings are offered through Dodge distributors in both expansion and non-expansion types and are stocked in sizes to fit shafts from 2 7/16 to 8 in. diameters.

Portable Scaler

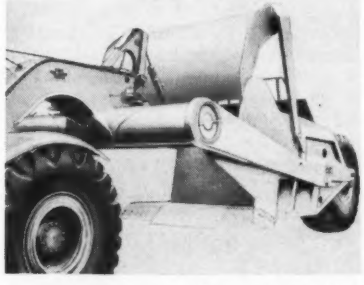
A BATTERY OPERATED instrument, the Model 2800 Portable Scaler —for use with Geiger or other radiation measuring counters — performs with equal high accuracy from its self-contained rechargeable battery or from an a-c line, according to Nuclear —Chicago Corp., 229 West Erie St., Chicago 10, Ill.

The unit has a wide band feedback amplifier, five glow—tube decades providing a scaling range of 100,000 with pushbutton reset, test position spring-wound timer providing a predetermined time counting range from 0.25 to 6 minutes with a stop-count switch, regulated high voltage supply, a self-contained battery charger regulator.

Tractor and Scraper

A FOUR-WHEEL prime mover and matching scraper combination has been announced by Caterpillar Tractor Co., Peoria, Ill. This rubber-tired unit is the Caterpillar DW 15 (Series E) Tractor and No. 428 Lowbowl Scraper.

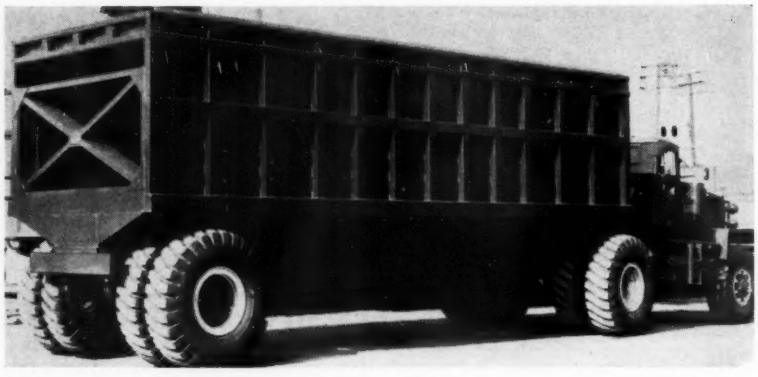
The tractor incorporates design changes in several major components, including the engine and power train.



A new Caterpillar Diesel Engine has reportedly been designed for the DW 15 (Series E), and develops 200 (maximum output) hp at 2000 rpm. The tractor incorporates a ten-speed transmission which offers working speeds from 2.7 to 37.2 mph, and major components of the drive train are said to have been given additional strength for longer service life. Tubeless tires are being offered as standard equipment.

The No. 428 Scraper incorporates Lowbowl design and has a struck capacity of 13 cu yd, heaped capacity of 18 cu yd.

Axle Suspensions



LIGHT WEIGHT, easier ride, shock absorbing qualities and load equalizing—all of these advantages are claimed for the Hendrickson Single and Tandem Axle Suspensions which cover the complete range of capacities from 22,000 to 150,000 lb. In both the tandem and single units, rubber replaces the steel leaf spring to give a cushioned ride. Automatic cushioning and alignment are accomplished by four drive pins encased in rubber bushings. The pins move vertically in direct relation to the movement of the load cushion.

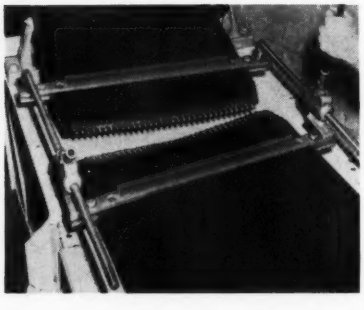
Hendrickson Mfg. Co., Lyons, Ill., recently announced a special application of its 80,000 lb Model RS Single Axle Suspension to an 80-ton, 60 cu yd water level capacity coal trailer.

Forged Steel Union

RATED 1500 LB steam working pressure at 900°F, a new Petro 6000 lb CWP forged steel union is now available with special heavy duty walls for power piping at higher pressures and higher temperatures, according to Clayton Mark & Co., Evanston, Ill. Available in nine sizes, the Petro unions may be obtained both in threaded and socket weld types.

Belt Clamp

EMPLOYING JACKS in place of take-up screws, the Far-Pul belt clamp for installing conveyor belts reportedly can be operated by one man. Each end of the belt is clamped between



bars, one set of which is equipped with jacks and tensioning rods. The tensioning rods are slipped over studs on the opposite bar clamp. The ends of the belt are drawn together by the jacks. When fasteners mesh properly, pin is inserted through loops of lacing or fasteners. Tension on jacks is released, clamps are removed from belt and the belt is ready to operate.

The Far-Pul can also be used to shorten a conveyor belt joined with Flexco or Flexco Hinged Fasteners. Request Bulletin FP-1 from Flexible Steel Lacing Co., 4607 Lexington St., Chicago 44, Ill.

Machine Key Stock Bars

CONTAINING SEVEN genuine machine key bars of different sizes which may be filed to fit 11 different keyways, the 7-11 Mak-A-Key Kit provides a convenient assortment of key stock for repair and maintenance departments, tool rooms and shops. The kit is manufactured by DeVan-Johnson Co., 500 Rathbone Ave., Aurora, Ill.

Rotary Exploration Drill

THIS PORTABLE rotary vacuum circulation type exploration drill, called the Mighty Midget, weighs 125 lb. Drill steel that weighs 92 lb per 100 ft completes the "pack or plane" exploration sampling equipment.

It is claimed that the vacuum circulation and collection of cuttings produces a number of important results: (1) 100 percent cuttings recovery, (2) uncontaminated cuttings, (3) ready drilling through broken or caving grounds, (4) no leaching or hydration of samples, (5) no water necessary in drilling.

Interchangeable carbide or diamond bits are used—with or without a core barrel as desired. Drilling reportedly can be done at any angle to depths of over 100 ft. Larger models are designed for depths to 2000 ft.

Write for data sheet describing the Mighty Midget to Allied Geophysics, P. O. Box 538, San Jose, Calif.

Selective Signaling Package

THIS SINGLE-UNIT Quick-Call Console provides complete selective calling facilities for land-mobile two-way radio base station installations, according to Motorola, Inc., Communications & Industrial Electronics Division, 4501 W. Augusta Blvd., Chicago 51, Ill.

The console is said to combine all tone signaling elements, including tone generator, timer, power supply and code selector, in a single package —and can be added to any existing two-way radio system. Over-all dimensions are approximately 13 by 10 by 7 in.; weight is 24 lb.

Hole Digger

AN AUTOMATIC DIGGING TOOL, The Roper Hole Digger will dig a straight or angle hole from any jeep, truck, or tractor equipped with front or rear boom and winch. Interchangeable augers from 6 to 24 in. in diameter are available with the hole digger which does not need power transmission drives in order to operate. A gasoline motor is mounted directly above the auger.

The hole digger comes with standard six-ft augers with extensions available up to 25 ft. Write for further information to The Roper Manufacturing Co., 204 Elm St., Zanesville, Ohio.

Hydraulic Lifting Jack

RATED AT 100 TONS with a lifting height of 6⅛ in., the Model 100B-12 is equipped with a tandem pump to permit rapid engagement of the load. By actuating both high-speed and high-lift plungers, the operator quickly brings the ram in contact with the load. Using the high-lift plunger alone, the load is then lifted. Dual release valves in the base can be operated from either side. The jack base is drilled and tapped for a pressure gauge, an optional extra-cost feature.

Further information can be obtained from Western Railroad Supply Co., 2400-2434 South Ashland Ave., Chicago 8, Ill.

Radiotelephone

A MOBILE AM radiotelephone, the TR 245 may be installed in cars, trucks, jeeps or other vehicles, permitting these mobile units to keep in constant touch with a base station or each other. Using a frequency range of 1.6-8 Mc, this 50-watt two-way unit has a strip chassis construction, optional dual channel operation, and 6 or 12-volt operation without modification. The transmitter reportedly features quick heating tubes (PA and modulator), a pi output network, and a speech clipper and filter; the receiver features a delayed and amplified AVC, an automatic noise limiter, and a positive squelch circuit.

Request further data from Kaar Engineering Corp., Box 1320, Palo Alto, Calif.

Diesel Engine

TWO ENGINES have been announced by Caterpillar Tractor Co., Peoria, Ill. They are the D318 (Series G) and D315 (Series G) Diesel Engines, smaller and lighter modifications of the basic D318 and D315 which will remain in the Caterpillar line. They are available either naturally aspirated or with turbocharger. The D318 (Series G) engine develops 137 hp at 2000 rpm; turbocharging increases this rating to 175 hp. The D315 (Series G) develops 91.5 hp, but when turbocharged, the engine rating increases to 115 hp.

Diaphragm Pump

THIS FOUR-IN. Denver Adjustable Stroke Diaphragm Pump offers capacities to 70 gpm for simplex and 140 gpm for duplex at a horsepower of ¾ to 1 depending upon specific gravity of pulp. Adjustment can be made while pump is operating. For information write Denver Equipment Co., P. O. Box 5268, Denver 17, Colo.

Two appointments in the Mining Division of **Mine Safety Appliances Co.** have been announced.

E. M. White, formerly assistant

E. M. White

W. C. Hamilton

manager of the mining department, has been named sales manager of the Mining Division and **W. C. Hamilton**, formerly section supervisor of the general engineering department, was appointed mining operations manager.

The Cleveland Worm & Gear Co. and its affiliate, **The Farval Corp.**, announce the election of **George H. Acker** as president and **Howard Dingle** as chairman of the board of both companies.

Wallace Collett is appointed product sales manager, Material Handling Department, Tractor Group, **Allis-Chalmers Mfg. Co.**

William E. Sprackling, executive vice-president of **Anaconda Wire & Cable Co.**, was recently elected president and chief executive officer. He succeeds **H. Donn Keresey** who was elected board chairman.

Expansion of the sales department, Construction Machinery Division, **Allis-Chalmers Mfg. Co.**, by the creation of a new department within sales is announced by the company. **V. M. Holloway**, assistant sales manager of the division, is promoted to head of the new department, which will devote its full time to growth development of dealers and their sales organization. **J. M. Haile** is promoted to assistant sales manager to take over the duties of Holloway. **K. A. New** succeeds Haile as eastern territory manager.

Three new vice-presidents have been elected to the board of directors of **Gardner-Denver Co.** Elected were **George W. Gutekunst**, general sales manager; **C. H. Rieman**, general manager of the Denver plant, and **Brice D. Maddox**, general manager of the Keller Tool Division.

Edgar R. Phillips, sales manager, **Lee-Norse Co.**, announces that his company has opened a warehouse in Pocahontas, Va. This new addition to the company's facilities is intended to furnish its Southern Appalachian customers with swift service and delivery on equipment and parts.

The White Motor Co. has purchased the assets of **Reo Motors, Inc.**, Lansing, Mich., for an undisclosed amount of cash. White Motors will operate Reo as a Division under the direction of **John C. Tooker** who will be general manager of this Division. Reo is one of the oldest producers of motor trucks and has pioneered many new developments in the industry.

CATALOGS & BULLETINS

THERMAL DRYING. *McNally Pittsburg Manufacturing Corp., Pittsburg, Kan.* Bulletin 756 contains technical data on McNally's thermal dryers. Included in the 20-page brochure is a complete description with gas flow diagrams, dimension drawings, installation drawings of the McNally Vissac, McNally Pluso and McNally Cascade Dryers.

COTTRELL AUTOMATION SYSTEM. *Research-Cottrell, Inc., Bound Brook, N. J.* Bulletin describes the Cottrell automation system which is said to bring complete automation to the power inputs of electrostatic precipitators, eliminating manual adjustments and increasing round-the-clock dust and fume collection efficiencies.

WEATHER-PROTECTED MOTORS. *Allis-Chalmers Mfg. Co., P. O. Box 512, Milwaukee, Wis.* Features which contribute to the outdoor dependability of Allis-Chalmers weather-protected motors (Type FOD) in ratings from 250 to 900 hp are described in bulletin 51B8606A.

IH UNITS AS MINING TOOLS. *International Harvester Co., Construction Equipment Division, 180 N. Michigan Ave., Chicago 1, Ill.* Entitled "You Can Cut Costs and Increase Production With Modern International Equipment for Mining," Folder CR-526-G displays the entire IH construction equipment line at work on mining jobs in various sectors of the country.

WIRE ROPE SLINGS. *Advertising Dept., The Colorado Fuel & Iron Corp., 575 Madison Ave., New York, N. Y.* Three new folders describing suggested applications and ordering specifications for wire rope slings have been made available by the Wickwire Spencer Steel Division of the Colorado Fuel & Iron Corp. Folders describe Wickwire's Uniflex, Multiflex and Maxiflex wire rope slings.

STEEL TUBING & FITTINGS. *H-P Products, Inc., Louisville, Ohio.* Written for those that may be called upon to design, purchase and install tubing systems for vacuum or conveying, Bulletin No. V-157 gives specifications on Vacu-Flo Steel Tubing and Fittings.

(*Continued on page* 92)

(*Continued from page 91*)

HIGH PRESSURE HOSE COUPLINGS. *Le-Hi Division, Hose Accessories Co., 2704 No. 17th St., Philadelphia 32, Pa.* Describing and illustrating Le-Hi Heavy Duty High Pressure Hose Couplings, Bulletin No. 115 covers applications of high pressure air, steam, gas, hydraulic, liquid, etc., used according to the manufacturer everywhere in construction, mining, contracting, petroleum refining, and in general industry.

OIL & URANIUM EXPLORATION EQUIPMENT. *Nucleonic Corp of America, 196 DeGraw St., Brooklyn 31, N. Y.* The detailed technical information supplied in Catalog No. 101 makes it most helpful in the selection of equipment for oil and uranium exploration. A request on your company letterhead will bring you this convenient catalog free of charge.

DUST CONTROL SYSTEMS. *The Johnson-March Corp., 1724 Chestnut St., Philadelphia 3, Pa.* Systems of controlling dust in rock crushing plants are described in this brochure. Illustrated are important points where the systems, known as Chem-Jet, can be applied. Equipment and Compound M-R surface active agent used with the systems are also described.

HOW TO OPERATE A LIFT TRUCK. *Hyster Co., 2902 N. E. Clackamas St., Portland 8, Ore.* The two-color cartoon technique used in this booklet is designed for easy reading and is packed with information about the operation of a lift truck, preventive maintenance, safety and basic materials handling. Slanted for both the beginner and the experienced operator, Form 1214 also includes drawings for setting up an obstacle course.

PUMP. *Layne & Bowler Pump Co., 2943 Vail Ave., Los Angeles 22, Calif.* Showing detail cutaway sections of all components, Verti-Line Bulletin 600 describes the Verti-Line turbine pump, enclosed line-shaft type. Designed for primary water supply, there are models for capacities from 20 to 10,000 gpm and pressures to 650 psi.

TAPE. *Advertising Dept., Boston Woven Hose & Rubber Co., Boston 3, Mass.* Catalog features a complete line of Bull Dog brand friction, rubber, and plastic tape. It also describes the Bull Dog Premium Brown friction tape and contains illustrations, reference charts, and helpful descriptive information.

FEEDER. *Universal Engineering Corp., 625 "C" Ave., N. W., Cedar Rapids, Iowa.* Literature covers a wide range of sizes of the Wobbler Feeder. Employed on the Mesabi range for over five seasons, the use of this feeder has been extended by the Universal Engineering Corp. to quarrying, dam construction, cement, bauxite, slag, clay and coal.

SINTERED PLATE STORAGE BATTERIES. *Nickel Cadmium Battery Corp., 66 Pleasant St., Easthampton, Mass.* NICAD's sintered plate nickel cadmium storage batteries are described. Details of development, construction, and operation are shown along with curves of discharge and charge characteristics.

TORQUE CONVERTERS. *National Supply Co., Two Gateway Center, Pittsburgh, Pa.* Heavy-duty, single-stage hydraulic torque converters for transmission of 100 to 1000 hp to mining machinery are described in Bulletin No. 468. The brochure gives features and specifications of 17 sizes and capacities of National torque converters for matching with engines in this power range.

HANDBOOK OF INDUSTRIAL EQUIPMENT. *General Industrial Co., 5736X Elston Ave., Chicago 30, Ill.* Handbook contains specifications and descriptive data on office and factory equipment. Featured are such items as shelf trucks, lockers, small parts cabinets, hand dryers, fireproof blueprint cabinets and glass door display cases.

SKID-SHOVEL. *Construction Equipment Division, International Harvester Co., 180 N. Michigan Ave., Chicago 1, Ill.* Booklet CR-521-F describes the 2¼ cu yd International Drott TD-14 four-in-one Skid-Shovel. Job-site photos illustrate the adaptability of the unit, in its quick-change from Skid-Shovel to clamshell to bullclam to bulldozer.

FUEL INJECTION SYSTEM. *Cummins Engine Co., Inc., Columbus, Ind.* Booklet describes the Cummins PT Fuel Injection System. Cutaway views of the four PT fuel pump assemblies as well as the PT injector are provided, and a section is devoted to optional governor arrangements. The PT Fuel System is adaptable to all Cummins Diesels built since 1932.

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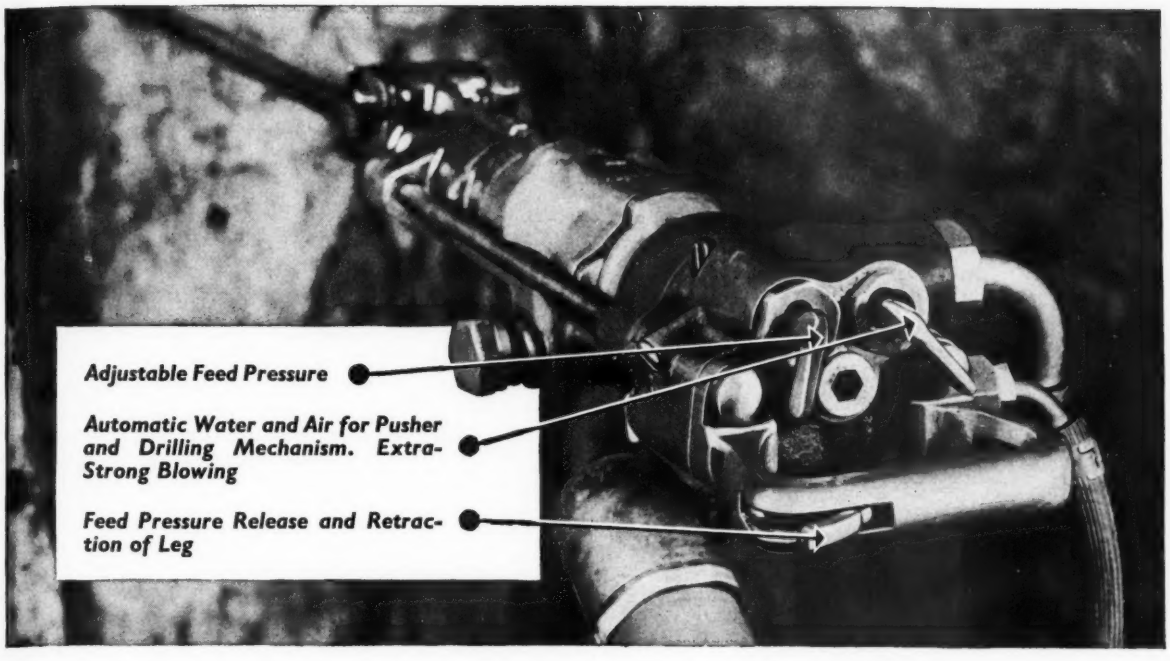

Adjustable Feed Pressure
Automatic Water and Air for Pusher and Drilling Mechanism. Extra-Strong Blowing
Feed Pressure Release and Retraction of Leg

THE ATLAS COPCO LION— A REVOLUTIONARY NEW ROCK DRILL

All controls under one hand

The Atlas Copco Lion is the first drill to have all the valves which operate the drill under the control of one hand. *Full and easy control without having to move the hand from the backhead!* All the controls have been designed so that they are well protected. While using them the operator's hand is never near the wall or roof of the drift. The Lion is the first pusher leg drill with controls placed for drifting.

Retractable leg saves time

When the leg has to be moved the feed pressure is easily released by squeezing the hand grip. By further pressure on the grip the leg retracts automatically. When the leg is in the new position suitable for continuous drilling, retraction stops and the feed pressure comes back by loosening the grip of the hand. *All this can be done while the drill is still running.*

This new idea of a retractable leg enables quicker repositioning of the leg and reduces the number of steel changes, thereby increasing footage per manshift. When drilling high holes it is now far easier to alter the position of the leg more frequently in order to maintain an optimal feed angle and feed pressure.

Packed with power for deep holes

The Lion has a drilling rate at least 30% higher than other rock drills of the same weight. Furthermore, it can maintain its high speed *even when drilling deep holes*. This means quickly drilled deep hole rounds and a faster advance. The Lion also reduces *to a minimum* the gauge wear of the bits in abrasive rock. And owing to the ease with which the feed pressure is released and brought back into action, the Lion is a *handier* drill to work with in fissured rock.

Sandvik Coromant—the steel for the Lion

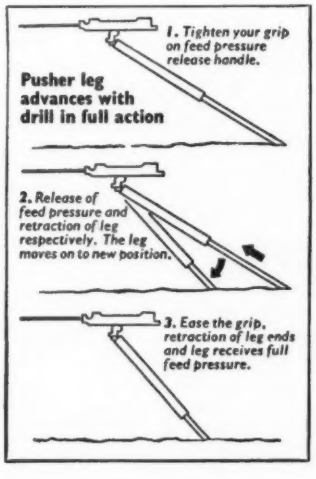
All Atlas Copco drills—and this goes for the Lion too—have been developed from the earliest stages with Sandvik Coromant tungsten-carbide-tipped integral steels and detachable bits. This combination pioneered tungsten carbide drilling in the early forties. No drill or steel developed separately could ever give such equivalently high performances as this drilling combination. Today it is the most widely used in the world, responsible for drilling more than 1,000 million feet annually.

For further information on the Atlas Copco Lion rock drill, and details of sales and service, please contact:

U.S.—Atlas Copco Pacific, Inc., 930 Brittan Avenue, San Carlos, California, or Atlas Copco Eastern Inc., P.O. Box 2568, Paterson 25, N.J.

CANADA—Atlas Copco Canada Limited, Montreal Airport, P.Q.

MEXICO—Atlas Copco Mexicana S.A., Apartado Postal 56, Torreon, Coahuila.


1. Tighten your grip on feed pressure release handle.
Pusher leg advances with drill in full action
2. Release of feed pressure and retraction of leg respectively. The leg moves on to new position.
3. Ease the grip, retraction of leg ends and leg receives full feed pressure.

Atlas Copco

D1E74A

Manufacturers of Stationary and Portable Compressors, Rock-Drilling Equipment, Loaders, Pneumatic Tools and Paint-Spraying Equipment

"Talk up" increased production—greater safety...with these M-S-A COMMUNICATION SYSTEMS

M-S-A MINEPHONE

Dispatcher sends orders instantly and simultaneously to all motormen with this modern, underground two-way voice communication system. Motormen receive and reply while trips are in motion—keep haulage movements coordinated with production demands. This results in smoother, faster, and more continuous trip movements throughout the mine.

Messages clear tracks for outgoing loaded trips and incoming empties. This system puts an end to traffic tie-ups, errors and accidents; prevents excessive stop-and-start strain on equipment. Write for more detailed information.

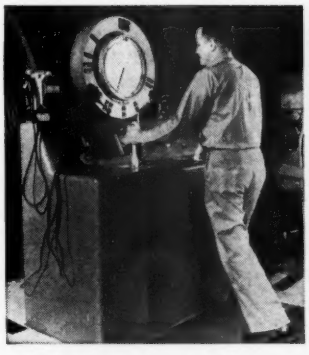
• Dispatcher sends orders to motormen . . . routes right-of-way traffic . . . receives reports on positions and station conditions.

• "Jeep" operator requests instructions from dispatcher and maintenance shop for section assignment . . . speeds emergency repair.

M-S-A HOISTPHONE

For accurate, instant response between the hoisting engineer and cage, here's the voice communication system to install. Whatever the job—load leveling—shaft repairs—shaft inspection trips—passenger transportation—the M-S-A HoistPhone provides better safety and efficiency through dependable, continuous two-way voice communication at any level, and while the cage is in motion.

Requires no special training . . . simple to use . . . dependable in operation. Write for further information.



• The hoisting engineer is able to control all movements of the cage by communicating with cage rider over the M-S-A HoistPhone.

• Worker uses microphone in cage to tell the hoisting engineer where he wants to go. Loudspeaker mounted on top of cage.

M-S-A
SAFETY EQUIPMENT HEADQUARTERS

When you have a safety problem, M-S-A is at your service . . . our job is to help you

MINE SAFETY APPLIANCES COMPANY
201 North Braddock Avenue, Pittsburgh 8, Pa.
At Your Service: 77 Branch Offices in the United States and Mexico

MINE SAFETY APPLIANCES CO. OF CANADA, LTD.
Toronto, Montreal, Calgary, Edmonton, Winnipeg, Vancouver, Sydney, N.S.

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